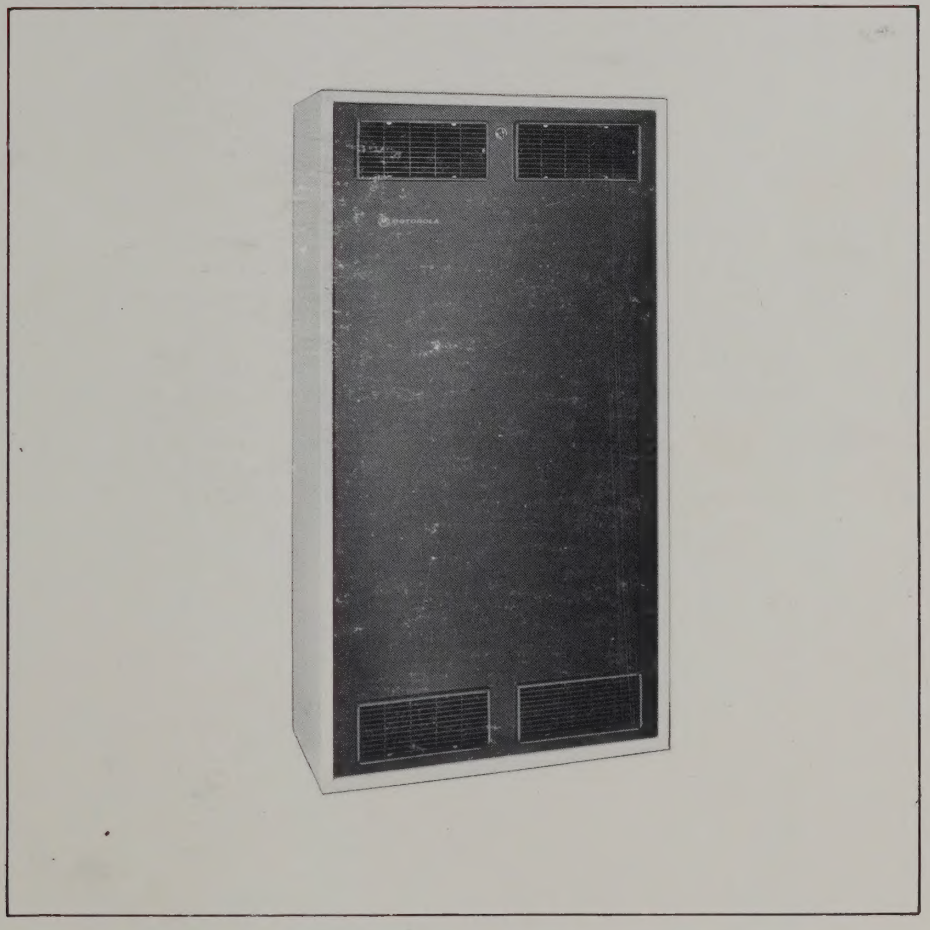
MOTOROLA

PURC™
Radio Paging Station
928-960 MHz Transmit



This Manual Must be Used With Control and Applications Manual 68P81060E70

68P81062E70-O

COMMERCIAL WARRANTY
(STANDARD)

Motorola radio communications products are warranted to be free from defects in material and workmanship for a period of ONE (1) YEAR, (except for crystals and channel elements which are warranted for a period of ten (10) years) from the date of shipment. Parts, including crystals and channel elements, will be replaced free of charge for the full warranty period but the labor to replace defective parts will only be provided for One Hundred-Twenty (120) days from the date of shipment. Thereafter purchaser must pay for the labor involved in repairing the product or replacing the parts at the prevailing rates together with any transportation charges to or from the place where warranty service is provided. This express warranty is extended by Motorola Communications and Electronics, Inc., 1301 E. Algonquin Road, Schaumburg, Illinois 60196, to the original purchaser only, and only to those purchasing for purpose of leasing or solely for commercial, industrial, or governmental use.

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED WHICH ARE SPECIFICALLY EXCLUDED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW.

In the event of a defect, malfunction or failure to conform to specifications established by seller, or if appropriate, to specifications accepted by Seller in writing, during the period shown, Motorola, at its option, will either repair or replace the product or refund the purchase price thereof, and such action on the part of Motorola shall be the full extent of Motorola's liability hereunder.

This warranty is void if:

a. the product is used in other than its normal and customary manner;
b. the product has been subject to misuse, accident, neglect or damage;
c. unauthorized alterations or repairs have been made, or unapproved parts used in the equipment.

This warranty extends only to individual products, batteries are excluded, but carry their own separate limited warranty. Because each radio system is unique, Motorola disclaims liability for range, coverage, or operation of the system as a whole under this warranty except by a separate written agreement signed by an officer of Motorola.

Non-Motorola manufactured products are excluded from this warranty, but subject to the warranty provided by their manufacturers, a copy of which will be supplied to you on specific written request.

In order to obtain performance of this warranty, purchaser must contact its Motorola salesperson or Motorola at the address first above shown, attention Quality Assurance Department.

This warranty applies only within the United States.

EPS-27734-O

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EPS-34440-A

68P81112E94-A

MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81062E70-O PURC Radio Paging Station

REVISION DETAILS:

The Receiver Alignment procedure (PEPS-35633) located in the Receiver section (68P81063E26) has been modified. Replace the existing receiver alignment procedure with this updated receiver alignment procedure. See the reverse side of this page.

D. RECEIVER ALIGNMENT

Step	Adjust	Meter Position	Stage and Procedure
1	L101, L102, L103, L104, L105		MULTIPLIER COILS — Adjust the cores of L101, L102, L103, and L105 to the end of the coil form flush with the printed circuit board. Adjust the core of L104 to the end of the coil form away from the printed circuit board.
2	L110, L111, L112		FIRST I-F COILS — Adjust the cores of L110, L111, and L112 to the end of the coil form flush with the printed circuit board.
3	L106, L107, L113, L114, L115, L116, L117		PRESELECTOR AND INJECTION FILTER — Adjust the slugs at L106, L107, and L113 through L117 away from the rf deck until they stop. Adjust L106 four turns clockwise and L117 two turns clockwise.
4	L101, L102	1	CHANNEL ELEMENT OUTPUT — Adjust L102 two turns clockwise. Alternately turn L101 and L102 clockwise 1/2 turn at a time until a peak indication is achieved on meter 1.
5	L103, L104	2	FIRST DOUBLER — Tune L103 for a peak reading on meter 2. Tune L104 counterclockwise until meter 2 dips.
6	L104, L105	3	DOUBLE DOUBLER — Tune L105 clockwise until a peak reading is achieved on meter 3. Tune L104 until a peak reading is achieved on meter 3. Repeak L104 and L105 until no further improvement is obtained.
7	L108	4, 5	DISCRIMINATOR — Insert the center conductor of the output cable from a 11.7 MHz test oscillator into the L109 hole on the receiver shield. Do not contact the circuit board. Insert the conductor far enough to obtain a saturated reading on meter 5. By tuning L108, it should then be possible to obtain readings on either side of zero (center) on meter 4. Tune L108 for an EXACT zero (center) reading. *This adjustment is critical.*
8	L109	5	SECOND I-F COIL — Insert the 11.7 MHz injection probe into the L112 hole in the receiver shield. Tune L109 for a peak reading on meter 5, keeping meter 5 out of saturation by moving the probe.
9	C1	4, 5	SECOND OSCILLATOR WARP CAPACITOR — Insert the 45 MHz injection probe into the L112 hole in the receiver shield. Tune C1 until quieting is obtained and meter 5 increases. Tune C1 for an EXACT zero reading on meter 4. *This adjustment is critical.*
10	L110, L111, L112	5	FIRST I-F COILS — Insert the 45 MHz injection probe in the L110 hole on the receiver shield. Tune L112 clockwiise for a peak reading on meter 5, keeping the meter out of saturation by moving the probe. Tune L111 clockwise for a peak reading on meter 5, keeping the meter out of saturation. Remove the probe and turn L110 ten turns clockwise.
11	L106	4, 5	INJECTION FILTER — Unsquelch the receiver and connect an rf signal generator to the antenna connector. Set the rf output level of the generator to maximum and set the generator to the carrier frequency. Tune L106 for a peak reading on meter 5, reducing the generator level as necessary to keep meter 5 out of saturation.
12	L107, L105, L104	3, 5	Detune L105 until meter 3 drops to 10 uA. Tune L107 for a peak reading on meter 5. Tune L105 for a peak reading on meter 3. Repeak L104 and L105 until no further improvement is obtained.
13	L113, L114, L115, L116, L117	5	RF PRESELECTOR — Tune L117, L116, L113, L114 and L115 in that order for a peak reading on meter 5. Reduce the generator level as necessary to keep meter 5 out of saturation.
14	L113, L114, L115, L116, L117	5	Tune L113, L114, L115, L116, L117 in that order for best noise quieting.
15	F1	4	Adjust F1 channel element. Inject a known, accurate carrier frequency into the receiver. Adjust the channel element warp capacitor for a zero reading on meter position 4.
16	L110, L111, L112, L109	5	FM modulate the carrier frequency with a 1 kHz tone at 7.5 kHz deviation. Peak L110, L111, L112, and L109 in that order for a maximum reading on meter 5.
17	—	—	Perform 20 dB quieting sensitivity measurements to check alignment.

MOTOROLA INC.
Communications Sector

PURC PAGING BASE STATION
928-960 MHz TRANSMIT

CONTENTS

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

68P81062E70-O
12/1/82- UP

TRANSMITTER

RECEIVER

POWER SUPPLIES

FOREWORD

1. SCOPE OF MANUAL

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMR's are added to the manuals as the engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, the applicable schematic diagrams are updated.

As diagrams are updated, information about the change is incorporated into a revision column. This revision column appears in the manual next to the parts list or, in some cases, on the diagram. It lists the reference number, part number, and description of the parts removed or replaced.

3. SERVICE

Motorola's National Service Organization offers one of the finest nation-wide installation and maintenance programs available to communication equipment users. This organization includes approximately 900 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC licensed technicians.

These MSS's are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and material basis or on a periodic fixed-fee type arrangement.

The administrative staff of this organization consists of national, area and district service managers and district representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications and Electronics, Inc.
1303 E. Algonquin Road
Schaumburg, Illinois 60196

4. REPLACEMENT PARTS ORDERING

Motorola maintains a number of parts offices strategically-located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Group products.

Orders for all parts *except* crystals, active filters, code plugs, channel elements, and "Vibrasender" ® and "Vibrasponder" ® resonant reeds should be sent to the nearest area parts center. Orders for instruction manuals should also be sent to the area parts center.

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Orders for crystals, channel elements, active filters, PROMs, code plugs, and reeds should be sent directly to the factory address listed on the following page. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the chassis model number in which the part is used.

Orders for active filters, PROMs, code plugs, *Vibrasender* and *Vibrasponder* resonant reeds should specify type number and frequency, should identify the owner/operator of the communications system in which these items are to be used; and should include any serial numbers stamped on the components being replaced.

5. ADDRESSES

5.1 GENERAL OFFICES

MOTOROLA Communications and
Electronics Inc.
Communications & Electronics Parts
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60196
Phone: 312-576-3900

5.2 U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City,
San Mateo, California 94404
Phone: 415-349-3111
TWX: 910-375-3877

MIDWEST AREA PARTS
1313 E. Algonquin Road
Schaumburg, Ill. 60196
Phone: 312-576-7430
TWX: 910-693-0869

MID-ATLANTIC AREA PARTS
7230 Parkway Drive
Hanover, Maryland 20176
Phone: 301-796-8763
TWX: 710-862-1941

EAST CENTRAL AREA PARTS
12995 Snow Road,
Parma, Ohio 44130
Phone: 216-433-1560
TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road,
Glen Rock, New Jersey 07452
Phone: 201-444-9662
TWX: 710-988-5602

PACIFIC SOUTHWESTERN AREA PARTS
P.O. Box 85036
San Diego, California 92138
Phone: 714-578-8030
TWX: 910-335-1516

GULF STATES AREA PARTS
1140 Cypress Station
P.O. Box 73115
Houston, Texas 77090
Phone: 713-537-3636
TWX: 910-881-6392

SOUTHWESTERN AREA PARTS
P.O. Box 34290
3320 Belt Line Road,
Dallas, Texas 75234
Phone: 214-620-8511
TWX: 910-860-5505

SOUTHEASTERN AREA PARTS
P.O. Box 368
Decatur, Georgia 30031
Phone: 504-987-2232
TWX: 810-766-0876

5.3 CANADIAN ORDERS

MOTOROLA LTD.
National Parts Department
3125 Steeles Avenue East
Willowdale, Ontario M2H 2H6
Phone: 416-499-1441
TWX: 610-491-1032
Telex: 06-526258

5.4 ALL COUNTRIES EXCEPT U.S. AND CANADA

MOTOROLA, INC.
International Parts Dept.
1313 E. Algonquin Road
Schaumburg, Illinois 60196 U.S.A.
Phone: 312-576-6492
TWX: 910-693-0869
Telex: 722443
Cable: MOTOL PARTS

5.5 FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT, ACTIVE FILTER, CODE PLUGS, PROMs, AND RESONANT REED ORDERS

ALL MAIL ORDERS
Motorola, Inc.
Component Products Sales & Service
P.O. Box 66191
O'Hare International Airport
Chicago, Ill. 60666

CORRESPONDENCE
Motorola, Inc.
Component Products Sales & Service
2553 N. Edgington Street
Franklin Park, Illinois 60131
Phone: 312-451-1297
TWX: 910-227-0799
Telex: 433-0067

GENERAL SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard which applies to the use of this equipment. Proper use of this radio will result in exposure below the OSHA limit. The following precautions are recommended:

DO NOT operate the transmitter of a mobile radio when someone outside the vehicle is within two feet (0.6 meter) of the antenna.

DO NOT operate the transmitter of a fixed radio (base station, microwave and rural telephone rf equipment) or marine radio when someone is within two feet (0.6 meter) of the antenna.

DO NOT operate the transmitter of any radio unless all RF connectors are secure and any open connectors are properly terminated.

In addition,

DO NOT operate this equipment near electrical blasting caps or in an explosive atmosphere.

All equipment must be properly grounded according to Motorola installation instructions for safe operation.

All equipment should be serviced only by a qualified technician.

Refer to the appropriate section of the product service manual for additional pertinent safety information.

EPS-28750-O

PERFORMANCE SPECIFICATIONS

GENERAL

Model	C75JZB Series
Number of Frequencies	Single Frequency Stations (Local/Tone Remote Control/Simulcast Control)
AC Power Input	120 V, 60 Hz, single phase (3-lead grounding-type cable supplied)
AC Current	Standby: 2.6A at 121 V, 60 Hz Transmit: 7.6A at 121 V, 60 Hz
Metering	2 panel-mounted meters provide indication of power amplifier voltage & current essential for tuning and checking. Optional internal-mounted meter used to measure exciter & receiver circuits essential for tuning and checking.
Dimensions	60"H × 22.25"W × 19.25"D (150 × 55.6 × 48cm)
Weight	300 lbs. (140 kg)

TRANSMITTER

Frequency	928-960 MHz
RF Power Output	60 to 125 watts, variable
Output Impedance	50 ohms
Final RF Amplifier	3CX400U7 Type Tube
Frequency Stability	Standard Models: ±.0001% from −30°C to +60°C ambient (25°C ref.) Simulcast Models: ±.0000002% from −30°C to +60°C ambient (25°C ref.) ±.000004% per year long term aging
Conducted Spurious & Harmonic Emissions	−85 dB
Modulation	15F2, 16F3 & 16F9Y ±5 kHz for 100% @1000 Hz
Audio Sensitivity Local Control	0.12 V ±3 dB for 60% max. deviation @1000 Hz
Audio Response — EIA	+1, −3 dB from 6 dB/octave pre-emphasis 300-3000 Hz reference to 1000 Hz. Flat within ±1 dB 250-2800 Hz, reference to 1000 Hz (optional)
Audio Distortion	Less than 2% @1000 Hz; 60% system deviation
Remote Telephone Line	−20 dBm max. for 60% max. deviation @1000 Hz

MONITOR RECEIVER (OPTIONAL)

Frequency	928-960 MHz
Channel Spacing	25 kHz
EIA Modulation Acceptance	±8 kHz minimum
Selectivity — EIA SINAD	−80 dB
Frequency Stability	−.0002% from −30°C to +60°C ambient (+25°C ref.)
Sensitivity — 20 dB quieting EIA SINAD	Less than 0.5 uV Less than 0.35 uV
Intermodulation — EIA SINAD	−75 dB
Spurious & Image Rejection	100 dB
Squelch Sensitivity — Carrier Squelch (adjustable)	6 dB Quieting (.25 uV or less at threshold)
Audio Characteristics — Remote Control Models	Telephone Line: Output: +18 dBm at 600 ohms Response: +1, −3 dB Distortion: 3% at 1000 Hz Hum & Noise: −55 dB For Local Speaker: Output Available: 5 watts at 8 ohms Response: +2; −8 dB Distortion: 5% at 1000 Hz Hum & Noise: −50 dB
RF Input Impedance	Nominal 50 ohms

FCC INFORMATION

All Models	Applicable Part of Rules Parts 22, 90
Authorized Emissions	15F2, 16F3, and 16F9Y

Stability	Type Acceptance Number
Standard Models	ABZ89FC5601
Simulcast Models	ABZ89FC5602

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

MODEL	FREQ.	DESCRIPTION
C75JZB1101A	928-960 MHz	PAGING STATION (SYNTHESIZED)
C75JZB1106A	928-960 MHz	TONE REMOTE CONTROL

STATION MODEL CHART

CODE:

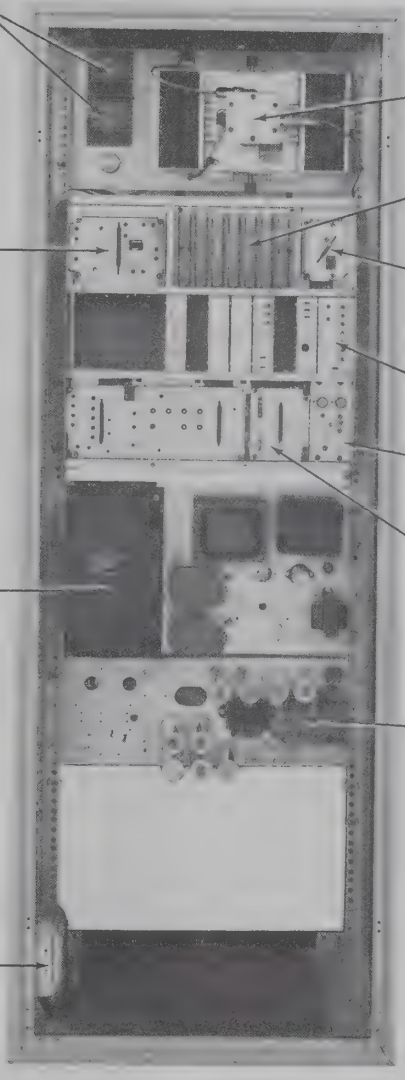
● = ONE SUPPLIED

C75JZB1101A	C75JZB1106A			ITEM	DESCRIPTION
●	●			TCN1367A	UNIFIED CONTROL CHASSIS
●	●			THN6304A	CABINET, 60"
●	●			TKN8212A	INTERCONNECT CABLE
●	●			TKN8214A	MODEM CABLE
●	●			TKN8244A	FUSE CABLE
●	●			TLF1192A	EXCITER & BANDPASS FILTER, 153-160 MHz
●	●			TLF1202A	HYBRID TRIPLER DOUBLER, 928-960 MHz
●	●			TLF1212A	IPA, 928-960 MHz
●	●			TLF1222A	PA, 125 W, 928-960 MHz
●	●			TLF1232A	DIRECTIONAL COUPLER
●	●			TLN2376A	GUARD TONE DECODER
	●			TLN4290B	AUDIO PA
●	●			TLN5703A	TRANSFORMER LB
●	●			TLN5891A	RCVR SHLD
●	●			TPN1147A	POWER SUPPLY HV
●	●			TPN1148A	POWER SUPPLY LV
●				TPN1195A	POWER SUPPLY, 24 V
●				TLE1342A	SYNTHESIZER, 928-960 MHz
●	●			TRN4845A	POWER CONTROL BOARD
●	●			TRN4846A	HARDWARE STATION, 125 W
	●			TRN4847A	OSC. BRKT
	●			TRN4853A	TRANSMITTER SITE INTERFACE MODULE
●	●			TRN4854B	STATION CONTROL MODULE
	●			TRN4856B	DIGITAL MODULATION MODULE
●	●			TRN4859A	STATION LINE DRIVER BOARD
●	●			TRN6192A	TRANSMITTER SHIELD, 12 W
●				TRN5481A	PROM
●	●			TRN6587A	POWER JUNCTION BOX
●	●			TRN6729A	BLOWER & SHROUD
	●			TRN8406A	AUDIO SQUELCH, 10 W
●	●			TRN8686A	CARD PULLER
●				TLN8799A	SERVICE BOARD
●				TRN5609A	SYNTHESIZER HARDWARE
	●			TLN4658A	F1 CONTROL MODULE
●				TLN2559A	SIMULCAST CONTROL MODULE
●				TLN5293A	F1 TONE DECODER MODULE
●				KXN1052A	XMTR CHANNEL ELEMENT

EPS-35191-O

Options Chart

Option	Description	Publication Reference
C11AC	Add Time-Out Timer	68P81044E69 p/o 68P81060E70
C36AW	75" Outdoor Cabinet	PEPS-21043
C40AQ	70" Indoor Cabinet & Meters	DEPS-15048
C47AD	Internal Wattmeter	68P81062E48 p/o 68P81060E70
C149BT	DC Metering w/Intercom	68P81033E28
C153AB	50' Modem Cable	None
C154AC	100' Modem Cable	None
C226AC	Service Intercom	PEPS-17760
C307AF	70" Indoor Cabinet w/o Metering	DEPS-15048
C366AB	Transmitter Flat Audio Response	PEPS-34631 p/o 68P81060E70
C501AH	Omit Transmitter Channel Element	None
C521AQ	Omit Receiver Channel Element	None
C578AA	Alarm Logic Module	68P81062E71 p/o 68P81060E70
C583AA	Voice Actuated Response	68P81048E69 p/o 68P81061E95
C659AF	UHF Link Receiver Carrier Squelch	68P81063E10
C660AF	900 MHz Link Receiver Carrier Squelch	68P81063E10
C661AF	72 MHz *Digital Private-Line* Squelch Link Receiver	68P81063E10
C662AF	UHF Link Receiver *Digital Private-Line* Squelch	68P81063E10
C663AF	Receiver 900 MHz Link	68P81063E10
C664AJ	Monitor Receiver Carrier Squelch 900 MHz	68P81063E10
C665AG	Monitor Receiver *Private-Line* Squelch 900 MHz	68P81063E10
C666AB	Omit Simulcast Control	None Required



FAEPS–35421–O
(M604)

1. MANUAL USAGE

This manual describes all aspects of the 928-960 MHz *PURC* (Paging Universal Remote Control) Paging Base Station radios except remote control and station applications. Separate Control and Applications manual 68P81060E70 describes how these stations are remotely controlled and outlines the functioning of the *PURC* Radio Paging Stations.

2. 900 MHz CONSIDERATIONS

Radio equipment operating in the 900 MHz band requires some special considerations over and above requirements for radios operating at lower frequencies. Some of these special considerations are:

- TEST EQUIPMENT — Test equipment must cover the frequency range and have the accuracy required. The 900 MHz base station transmitters have a frequency stability requirement of 0.0001% for the synthesized station, therefore, stability of frequency measuring devices should be at least ten times that of the transmitter (i.e. 0.00001%). Frequency generators used for alignment should be calibrated for both frequency and output in the 900 MHz band. Wattmeters, dummy loads, and termination devices should be checked for proper frequency specifications and calibrated required.

- CABLES AND CONNECTORS — Cable and connector attenuation is much higher at 900 MHz than at lower frequencies. Therefore, types RG8 and RG58 cables used at lower frequencies are not recommended for the 900 MHz band. Where flexible cable is required, recommended types are RG87 and RG400. "UHF" type connectors are not recommended for this frequency, instead, type "N" and "BNC" connectors are recommended. A particular phenomenon which can be noticed at 900 MHz is cable heating. Under normal operating conditions, rf cables can become warm or even hot. This is a normal condition and does not necessarily indicate a defective cable or a high VSWR ratio. To confirm malfunctions, insert a directional wattmeter in the line.

3. EQUIPMENT DESCRIPTION

3.1 TRANSMITTER

NOTE

Stations in the 900 MHz band are FCC-licensed to operate at or below a specified effective radiated power (ERP). The ERP of the station is related to the rf power output of the transmitter, antenna transmission line loss, antenna height and antenna gain. The maximum rf power output of the transmitter that will be permitted without violating the licensed ERP

NOTE (Cont'd.)

for each specific station must be determined by a communications specialist. This rf power figure may be equal to or below the maximum capability of the station. Record the figure for reference in future servicing and alignment of the station.

The transmitter generates a frequency modulated rf carrier signal of various power output levels. Refer to Figure 1 (block diagram) for functional operation. The transmitter consists of the following eight items:

- Channel Element or Synthesizer — A high stability, oven controlled crystal oscillator plug-in module (channel element) provides a stable fundamental rf frequency for the transmitter. A synthesizer replaces the channel element in synthesized stations.

- Exciter — the exciter provides the low power excitation signal for the transmitter. An *IDC* (Instantaneous Deviation Control) circuit amplifies and limits audio signals from the microphone (or line) to prevent over deviation. Amplified audio is applied to the channel element to produce direct FM modulation. Digital modulation is achieved by directly modulating the channel element as in the non- synthesized station. Multipliers in the exciter multiply the channel element frequency 12 times to generate an output frequency signal in the 154.66 to 160 MHz band.

- First Bandpass Filter — The first bandpass filter couples 154.66-160 MHz signals from the exciter to the tripler and doubler and attenuates any harmonics outside this band.

- Tripler/Doubler-Amplifier — The exciter output is tripled and doubled in these stages. A bandpass filter, electrically located between the tripler and doubler, filters the tripled signal and attenuates harmonics. A low level amplifier couples the doubler output to the intermediate power amplifier.

- Intermediate Power Amplifier (IPA) — The IPA is a variable 14 W amplifier used to drive the final power amplifier. Amplification is controlled by the power control board.

- Directional Coupler — The directional coupler samples forward power from the IPA and reflected power from the final power amplifier and applies both to the power control board.

- Power Control Board — The power control board operates as a control loop which examines forward and reflected power. It regulates the bias to the IPA, the drive power to the PA, and protects against excessive VSWR.

- Final Power Amplifier — The final power amplifier employs an EIMAC 3CX400U7/8961 UHF Transmitting Triode to provide a final rf power output of 60 to 125 watts. The unit is driven by the rf signal from the directional coupler. The output passes through a harmonic filter and is applied to the antenna output connector (or antenna relay, for stations with monitor receiver only).

3.2 RECEIVER

NOTE

This receiver description has been included for completeness only. Details about the receiver can be found in the Link Receiver Option manual (68P81063E10). The receiver is used in monitor receiver or link receiver options only.

The receiver accepts rf carrier signals on a specific channel in the 928-960 MHz range and provides voice audio in the 300-3000 Hz range. Refer to Figure 1 (block diagram) for functional operation. The receiver consists of the following items:

- Channel Element — A plug-in, temperature compensated crystal oscillator module (channel element) provides stable frequency control for each frequency of operation.

- Receiver RF and I-F Board — This double conversion, superheterodyne FM receiver includes a five cell preselector and three crystal filters for excellent selectivity. Two integrated circuit i-f amplifiers and limiters provide high sensitivity. A crystal discriminator demodulates the audio directly from an 11.7 MHz second i-f signal.

- Audio & Squelch and Audio Power Amplifier Boards — Up to 5 watts of audio power at less than 5% distortion is provided by this circuit. When no messages are being received, the squelch circuit turns off the audio amplifiers to eliminate annoying noise in the speaker. A squelch tail eliminator circuit prevents the noise burst at the end of a message for strong signals. For weak signals, the squelch tail eliminator circuit is automatically inhibited to prevent loss of portions of messages. The audio power amplifier transistors are mounted on a separate circuit board and aluminum heat sink for necessary heat dissipation.

3.3 POWER SUPPLY

This station uses a high and low voltage power supply system to provide station dc operating voltages. The station cabinet is provided with a safety interlock switch to reduce shock hazard.

- High Voltage Power Supply — The high voltage power supply produces the necessary voltages for plate current and PA tube bias and the ac voltages used to drive the low voltage power supply. It employs a ferro-resonant transformer to maintain output voltages to within ±3% with a ±20% line change.

- Low Voltage Power Supply — This power supply produces regulated dc voltages for the PA tube filament and all the solid-state circuitry of the station. It employs a filament protection and timing circuit for transmit inhibit during station warm-up.

4. VOLUME AND SQUELCH CONTROLS

Receiver VOLUME and SQUELCH controls are located on the receiver chassis (all other operational circuits and their controls are on plug-in modules inserted into the unified control chassis). The RECEIVER VOLUME control only affects local speaker operation (when used).

NOTE

The SQUELCH control affects both local and remote operation.

5. *DIGITAL PRIVATE-LINE* BINARY-CODED SQUELCH OPERATION

This type of operation is similar to *Private-Line* tone-coded squelch operation but with greatly expanded code capability. Refer to separate instruction manual 68P81106E83 for complete details. The receiver with DPL is used only in Link Receiver options.

6. ACCESSORIES

For a simulcast paging system at 900 MHz Motorola supplies all components that make such a system work effectively. The system includes paging terminals, simulcast system controllers, rf link equipment, rf synthesized paging stations and pagers. Please contact your Motorola area sales representative for further details. Some additional items required to complete the installation are:

6.1 ANTENNA AND TRANSMISSION LINE

An antenna and transmission line kit is available from Motorola on separate order. The type used should be determined by a qualified radio communications engineer and will depend upon local operating conditions.

6.2 OPTIONAL ACCESSORIES

Many optional accessories are available as factory installed items in new stations, and as "add-to" items for field installation. Many of those optional accessories

are described in this manual. Other accessories may become available after the printing of this manual. Also, other accessories are available which have more special application than those listed herein.

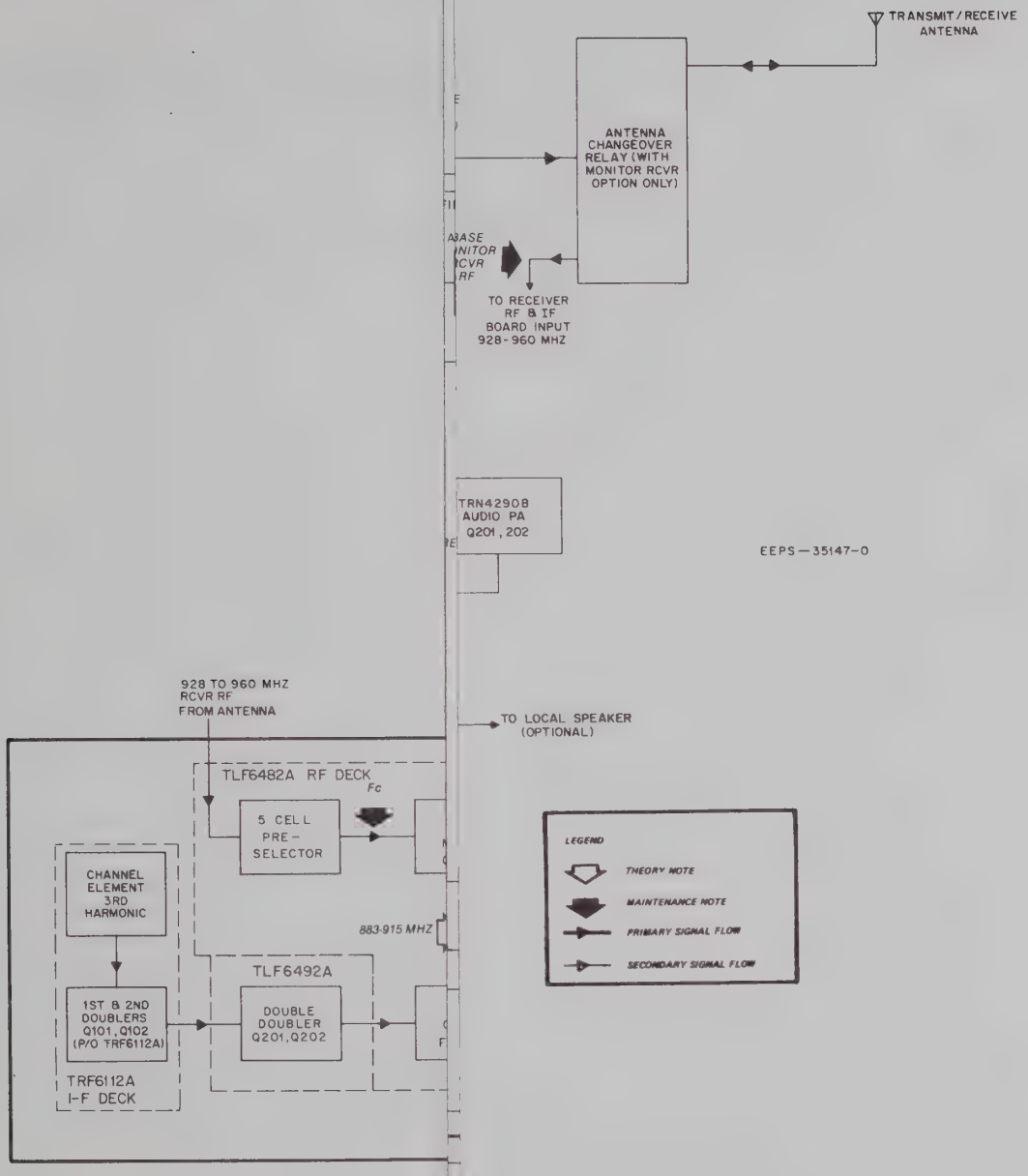


Figure 1. Transmitter/Receiver Block Diagram

are described in this manual. Other accessories may become available after the printing of this manual. Also, other accessories are available which have more special application than those listed herein.

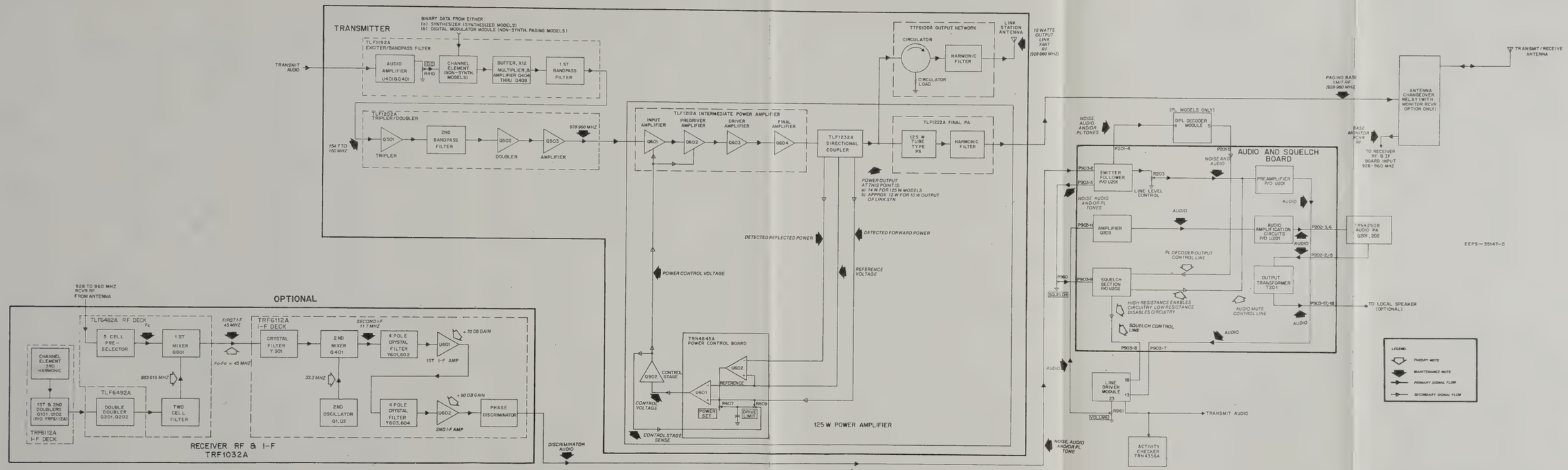


Figure 1. Transmitter/Receiver Block Diagram

INSTALLATION & INITIAL ADJUSTMENTS

1. UNPACKING

When unpacking the radio from its shipping carton, refer to the model chart at the front of this manual. If any item is missing, contact your Motorola representative immediately.

2. LICENSING REQUIREMENTS

FCC regulations state that a station license must be obtained for each radio installation (mobile or base) by the owner of the equipment. The station licensee is responsible for ensuring that the transmitter power, frequency, and deviation are within the limits permitted under the station license. Adjustments to the transmitter section of the radio may be made only by a technician possessing an FCC general class, or first or second class radiotelephone operator's license. No operator's license is required to install or operate the radio.

3. PLANNING THE INSTALLATION

Since a good installation is important to obtain the best possible performance of the communications system, carefully plan the installation before actual work is started. Location of the station in relation to power, control lines, the antenna, convenience and access for servicing should be considered. The cabinet dimensional detail diagrams show the size of the various cabinets for planning the space requirements. Read the entire procedure and the many suggestions offered to help you plan your installation. Make sure all tools, equipment and facilities are available when the installation is begun.

4. VENTILATION

Although a blower has been provided for cooling the PA tube, the remaining cabinet components are designed for operation without forced ventilation. The cabinet door has openings at the top and bottom, which provide a natural draft. It is therefore essential that the door openings be kept free of obstructions so air flow will not be restricted.

5. INSTALLATION OF 60-INCH INDOOR *COMPA-STATION* CABINETS

5.1 Refer to cabinet drawings at the end of this section for cabinet dimensional details.

5.2 The cabinet should be located on a solid, level surface convenient to the power source and the transmission line. The transmission line should be kept as short as possible to minimize line losses.

5.3 All antenna, power, and control lines may be brought through the notch at the bottom of the rear door. Any or all of these lines may be brought out through the bottom, side or top of the cabinet, if desired, by drilling a hole in the cabinet at the desired position.

CAUTION

Before drilling, check location of proposed hole and verify that equipment will not be damaged by the drilling.

6. INSTALLATION OF 75-INCH "OUTDOOR" CABINETS (OPTIONAL)

6.1 GENERAL

6.1.1 Refer to cabinet drawings at the end of this section for cabinet dimensional details.

6.1.2 The outdoor station may be installed in any convenient location (indoors or outdoors) which provides space to open the front and rear doors. If it is installed outdoors, the rain shield kit (which is packed with the cabinet) should be installed as described in this section. With these installed, the station is protected against all normally encountered elements such as rain, snow, or sleet.

6.1.3 The station is not intended to withstand submersion in water. If pools of water could gather around the cabinet base, it is recommended that the cabinet be elevated on a suitable supporting platform.

6.1.4 Although the cabinet is built to be installed outdoors, it should be realized that maintenance of the station is not easily accomplished in inclement weather. It is therefore recommended that the station be installed inside of an enclosure which would provide protection for the serviceman and the test equipment he may be using. One such enclosure would be an elevator penthouse or a small building no less than six feet square and eight feet tall as measured on the inside.

6.1.5 The cabinet should be located on a solid, level surface convenient to the power source and the transmission line. The transmission line should be kept as short as possible to minimize line losses.

6.2 75-INCH CABINET RAIN HOOD AND VENT SHIELD INSTALLATION

6.2.1 General

The rain hood is provided to cover the air vent in the top of the cabinet and the vent shield to cover the opening in the rear door.

6.2.2 Installation of Rain Hood

Step 1. Install the main section (largest fabricated assembly) over the opening in the top of the cabinet using the rectangular shaped gasket and 1/2-inch sheet metal screws provided.

Step 2. Mount the small rectangular cover inside the main section using the machine screws provided.

Step 3. Similarly, mount the larger cover on top of the whole assembly.

6.2.3 Installation of Vent Shield

Mount the awning-shaped vent shield over the opening in the rear door using the "U" shaped gasket and 3/8-inch sheet metal screws. Place the acorn nuts over the screws to cover exposed threads.

7. ANTENNA CONNECTIONS

7.1 INTRODUCTION

7.1.1 The antennas and transmission lines are not part of the station. Therefore, antenna installation instructions are not included in this section. Follow the instructions shipped with the antennas for applicable information.

7.1.2 In its primary application, the station is used for communication. Thus, antennas having omnidirectional characteristics are desirable. However, if the station is located at the outer perimeter of a communications area, or if it is to be used for communications with fixed stations, antennas with specific directional characteristics may be more suitable. FCC requirements may also dictate the type of antenna to be used.

7.1.3 For *PURC* Paging Base Stations, the antenna coaxial cable connects to the antenna network output with a type N connector. For *PURC* Paging Base Stations with the link receiver option, (without an optional duplexer), two antennas are required, one for the transmitter and one for the receiver. The antenna coaxial cables connect directly to the transmitter and receiver. The transmitter output requires a type N connector at the antenna network output — the receiver input requires a type BNC connector. For *PURC* Paging Base Stations with an optional monitor receiver option, an antenna relay is provided with the station. Only a single antenna is required. Both receiver and transmitter are connected to the antenna relay, which in turn is connected to the antenna. (Refer to Figure 1.)

7.1.4 Cable attenuation is a significant factor at 900 MHz. Therefore, whenever a flexible cable is needed, the recommended cables will be 30-83794C01 (RG87) and 30-84173E01 (RG400). If flexibility is not a requirement, then a heliax line should be used. In all usage of flexible cable, keep the line as short as possible.

7.2 60-INCH INDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

Step 1. The antenna coaxial cable(s) may be brought through the notch at the bottom of the rear door. Cable(s) may be brought out through the bottom, side, or top of the cabinet, if desired, by drilling a hole in the cabinet at the desired position.

Step 2. Connect the antenna cable(s) as shown in Figure 1.

CAUTION

Be careful to determine internal clearance before drilling access holes. A 3/4-inch diameter hole allows conduit to be installed for cable runs. If conduit is not used, install rubber grommets in the holes to protect the cable(s).

7.3 75-INCH OUTDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

Step 1. A flange-type bulkhead fitting should be used to make a weatherproof entry for the antenna transmission line(s). The recommended location for the fitting is on the right side of the cabinet (as viewed from the front) with its center 21 inches from the top and 7 inches from the rear. Any alternate location must be selected with caution to insure that the area is clear of chassis, framework, etc.

Step 2. Install connectors as required.

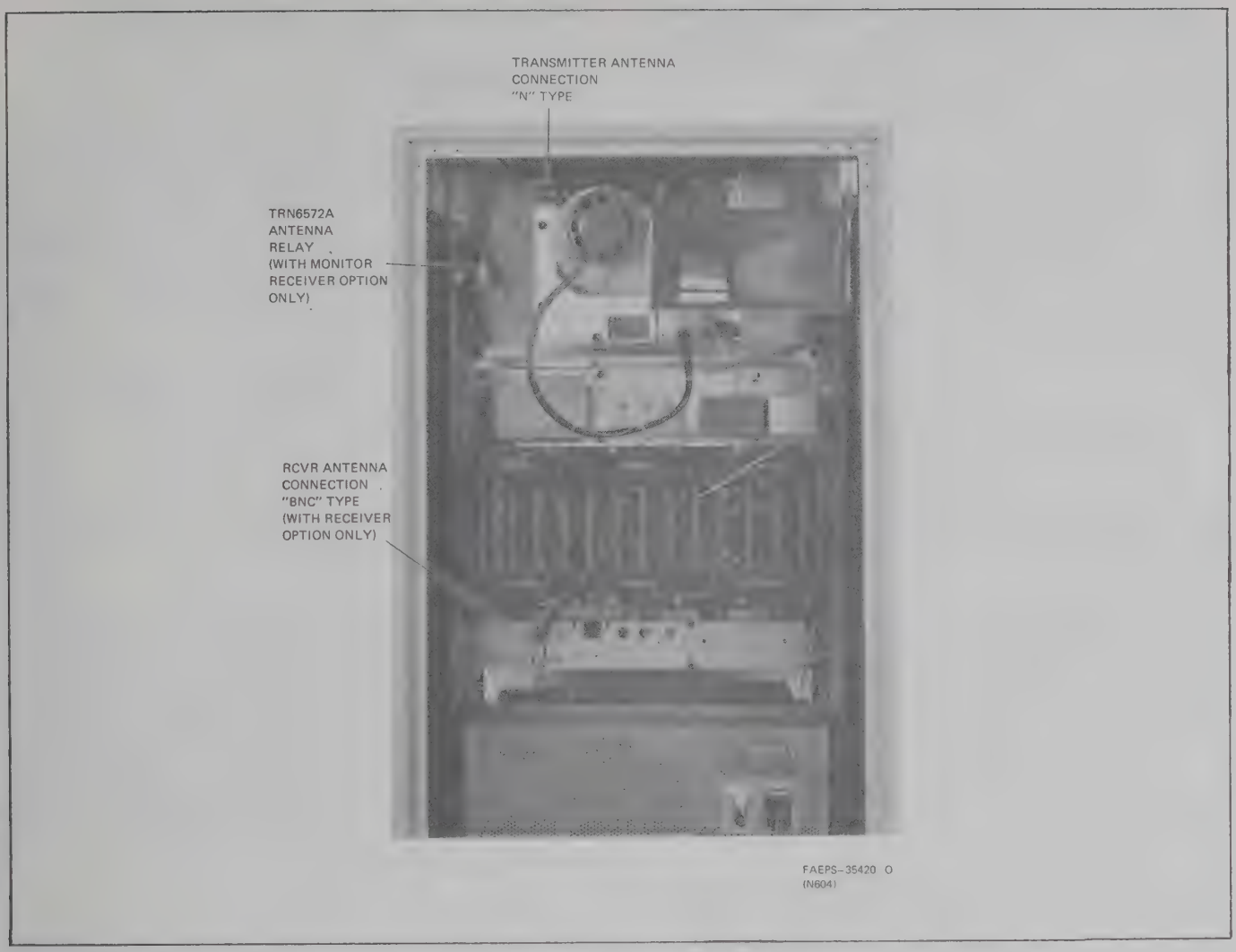


Figure 1. Antenna Connection Locations

8. AC INPUT POWER CONNECTIONS

8.1 INTRODUCTION

8.1.1 All stations should have a separate power circuit from a 10-ampere (minimum), 120 V ac, 60 Hz power source. The power lines should be installed in accordance with local electrical codes.

8.1.2 The primary ac power line may be installed prior to installation of the cabient and terminated near the location chosen for the station.

8.1.3 An ac power cord of 9 feet is supplied with each station. Direct conduit connections may also be made by replacing this power cord.

8.2 60-INCH INDOOR/CABINET POWER CONNECTIONS

8.2.1 Indoor and outdoor power connections are identical except that outdoor station requires additional weatherproofing.

WARNING

If a three wire grounded primary ac power source is not available, the radio equipment must be grounded separately to prevent electrical shock hazards and provide lightning protection.

8.2.2 Connect the three-wire ac line cord to the ac outlet. A power on-off switch is provided in the equipment.

8.2.3 All power to the station (except ac power to the outlet in the power supply) is protected by fuses.

8.3 75-INCH OUTDOOR CABINET POWER CONNECTION

8.3.1 For bottom cable entry, power and control cables may be brought in at almost any desired point through the bottom of the cabinet. Measure and center punch the desired cable entry locations. Using the

center punch marks as the center of the holes, drill 3/4-inch holes with a hole saw. Install rubber grommets in the holes to protect the cables. Seal the entry to make the opening as weatherproof as possible.

8.3.2 For rear cable entry, two punch marks are located on the rear panel of the cabinet base. Using these as centers, drill holes in the cabinet with a 3/4-inch hole saw. When facing the rear, the right-hand hole is intended for the entrance of ac power and the left-hand hole is intended for the entrance of control lines. Install rubber grommets in the holes to protect the cables. Seal the entry to make the opening as weatherproof as possible.

8.4.2 Transmission Lines Terminated in Female Connector

Step 1. Secure the transmission line (through the appropriate knockout) directly to the cabinet top with the nut supplied.

Step 2. Measure and cut a piece of coaxial cable so that it will reach between the station output connector and the transmission line connector in the cabinet top.

Step 3. Install the connectors as required.

9. OPTIONAL MODE JUMPERING

9.1 GENERAL

9.1.1 Many station modes of operation are determined by jumper connections at the time of installation.

9.1.2 All jumpers for control applications are described in *PURC* Control & Application instruction manual 68P81060E70. Additional jumpering may be found in applicable sections in this manual.

10. CONTROL LINE CONNECTIONS — INSTALLATION

10.1 GENERAL

The control line may be installed prior to installation of the cabinet and terminated near the location chosen for the station. Conduit or two-wire cable can be used from this termination to the station cabinet.

10.2 SPECIFIC CONNECTION INFORMATION

Connect the 600-ohm lines to the screw terminals on the rear of the unified chassis interconnect board as shown in Figure 2. (In 2-wire applications, use line 1 connections.)

11. CONTROL LINE LEVEL ADJUSTMENT

11.1 INTRODUCTION

Most telephone companies limit the maximum signal amplitude which they allow on their lines. This maximum amplitude is usually specified in RMS speech level is approximately 4 dB lower than a tone set at speech peaks. Therefore, when a tone set at peak speech level (such as the status tone from a *Spectra TAC* receiver) is used to set line level, it may be set 4 dBm above the specified RMS speech level.

NOTE

The following level setting information is applicable for non-simulcast systems.

11.2 PROCEDURE

11.2.1 General

11.2.1.1 A local speaker at the station may be used for testing and level settings. If the station is equipped with built-in metering, it includes a local speaker. If not, the speaker in a Motorola portable test set may be used by connecting the test set with *Micor* adapter to the control receptacle (J3) on the unified chassis interconnect board. Otherwise, a *Micor* mobile speaker can be connected to the local speaker pins (J4-1 and -12 of unified chassis interconnect board). The receiver VOLUME control set the audio level at the local speaker only.

11.2.1.2 Exciter audio should be measured at the microphone input to the exciter and adjusted for the sensitivity value stamped on the exciter. If the station is equipped with optional built-in metering, this may be measured at pins 1 and 2 of the local microphone jack. If not, it may be measured at J4-15 and -14 of unified chassis interconnect board or on the portable test set.

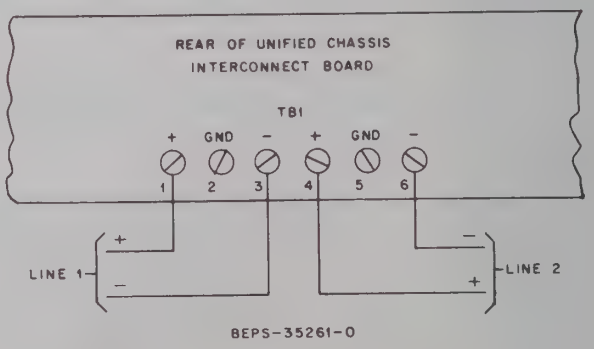


Figure 2. Control Line Connections

11.2.1.3 *Private-Line* squelch receivers must be PL disabled during adjustments with the PL DISABLE switch on the station control module. In *Private-Line* repeaters, the squelch gate must also be set for carrier squelch operation during adjustments by connecting jumper JU14 to the active pin and JU15 to the dummy pin. Be sure to return the jumpers to the PL condition after adjustments are complete.

11.2.1.4 If the station is equipped with a single-tone decoder module for repeater access unplug the single-tone decoder during adjustments.

11.2.2 Wire Line Controlled *PURC* Paging Base Stations

11.2.2.1 Determine the maximum allowable audio level permitted on the lines (use +2 vu for non-regulated lines) and set line audio levels to this amplitude. Refer to the 600 Ohm, VU, DBM and Voltage Equivalency Chart for tone levels to be used.

NOTE

The following procedures assume the +8 vu speech level (+14 dBm tone level). For other speech levels, use a tone level 6 dB higher than the vu level (for 0 vu use +6 dBm); refer to the equivalency chart. On some lines, tone levels are not permitted to exceed the speech levels, even for short test tones (for example, maximum speech level of 0 vu and maximum tone level of 0 dBm). When such regulations apply, use the special procedures for low level test tone.

11.2.2.2 As mentioned previously, the lines used to carry audio have an ac impedance of 600 ohms. The amplitude of signals is most conveniently measured in dBm. Zero dBm is equal to 1 milliwatt across 600 ohms. Most audio voltmeter, such as the Motorola Transistorized AC Voltmeter, are calibrated to read directly in dBm when measuring across a 600 ohm impedance. Never use a volt-ohmmeter or a multimeter.

Step 1. Apply a 1000 Hz audio tone to the remote control console at a level sufficient to drive the amplifier into compression. Adjust the output of the remote control console for +14 dBm (or maximum allowable audio level) at its output terminals.

Step 2. Adjust the XCTR LEVEL control (line driver module) so that the exciter audio input equals the value stamped on the exciter (modulator sensitivity plus 3 dB or approximately ±5 kHz transmitter deviation).

Step 3. Remove the 1000 Hz audio tone.

Step 4. Set the receiver SQUELCH control for squelch threshold.

Step 5. Inject a 1000 uV carrier frequency signal into the antenna input of the receiver. Modulate the signal with a 1000 Hz tone at ±5 kHz deviation.

Step 6. Adjust the LINE 1 OUTPUT (line driver module) for +11 dBm (3.9 V) or maximum allowable audio level as measured with an audio voltmeter across the line 1 terminals. If four-wire audio operation is used, with the receiver output applied to line 2, adjust the LINE 2 OUTPUT control while measuring across the line 2 terminals.

11.2.3 Special Procedure for Low Level Test Tone

NOTE

The following procedure is written for the 0 vu speech level and 0 dBm test tone level, but other levels may be used by substituting appropriate levels (levels across the 600-ohm load should be 6 dB higher than the specified line level).

Step 1. Terminate the remote control console in a 600 ohm load resistor rather than the line.

Step 2. Apply a 1000 Hz audio tone to the remote control console at a level sufficient to drive the amplifier into compression.

Step 3. Connect an audio voltmeter across the 600 ohm load resistor and adjust the line output for +6 dBm.

Step 4. Reduce the input 1000 Hz audio tone until the voltmeter reads 0 dBm.

Step 5. Remove the 600 ohm load resistor and reconnect the line. Readjust the line output for 0 dBm across the line. Do not change the input 1000 Hz tone level.

Step 6. Connect the audio voltmeter to the exciter audio input at the station and adjust the XCTR LEVEL control for 6 dB less than the value stamped on the exciter.

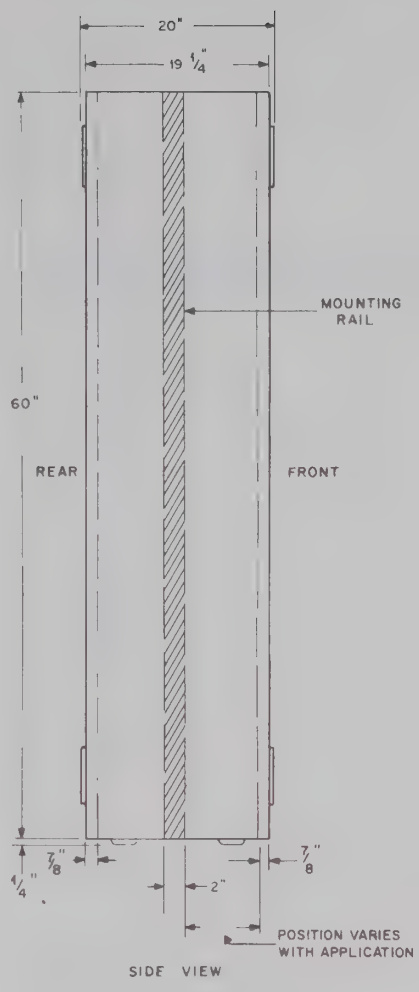
Step 7. Disconnect the line at the station and connect a 600 ohm load resistor in its place.

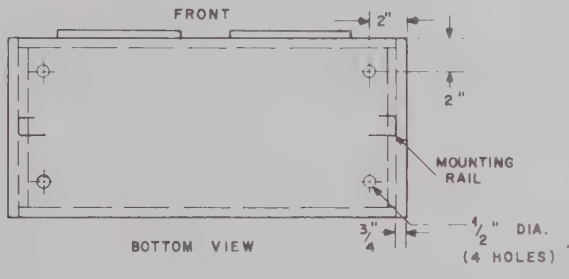
Step 8. Apply a 1000 uV carrier signal to the receiver antenna terminal from an FM signal generator. Modulate the carrier signal with a 1000 Hz tone at ±5 kHz deviation.

Step 9. Connect an audio voltmeter across the 600 ohm load resistor and adjust the LINE 1 OUTPUT control for +6 dBm.

Step 10. Reduce the deviation until the voltmeter reads 0 dBm.

Step 11. Remove the 600 ohm load resistor and reconnect the line. Readjust the LINE 1 OUTPUT for 0 dBm as measured across the line.





A = 22" CABINET WIDTH
B = 20-1/2" DOOR OPENING
C = 19-3/16" CABINET OPENING
D = 18-5/16" MTG. HOLE CENTERS
E = 17-11/16" CLEARANCE BETWEEN RAILS

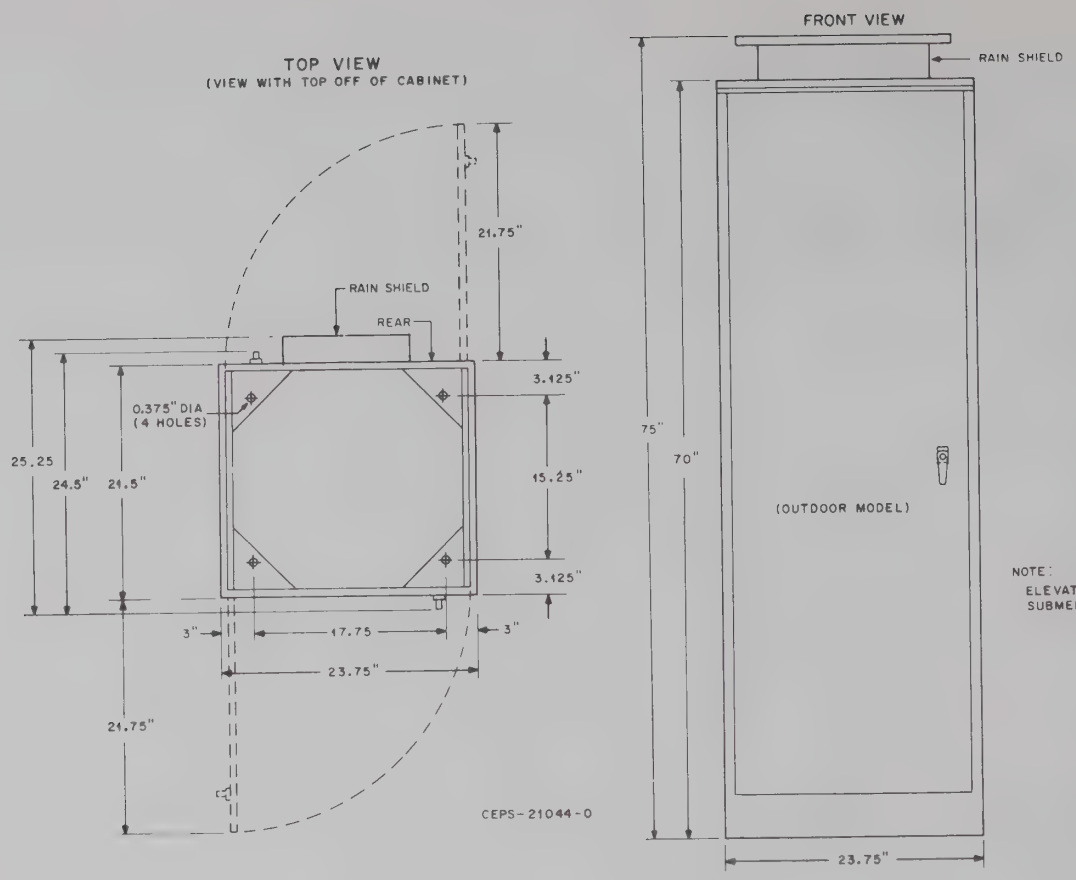
CEPS-17187-B

parts list

THN6304A Cabinet Kit (60-Inch) PL-4366-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	15-83445K04	CABINET (60-inch)
	13-84430D01	DOOR VENT (7 required)
	13-84430D04	DOOR VENT, HIGH TEMP (1 required)

THN6304A Cabinet (60 Inch Indoor)
Dimensional Detail and Parts List
*Motorola No. **PEPS-21129-A***
12/1/82- UP



parts list

THN6203A Cabinet 75" PL-5150-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	15-82123H05	CABINET

TRN6720A Rain Shield Kit PL-5151-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	26-82929H01	SHIELD, rain (top)
	26-84084F01	SHIELD, cover (top)
	15-82926H01	COVER, rain shield
	32-82499L01	GASKET, rain shield
	32-82499L02	GASKET; rain shield
	32-84180G01	GASKET; 2 req'd.
	32-84180G02	GASKET; 2 req'd.
	2-10080A03	NUT, spring: No. 8; 4 req'd.
	3-9661	SCREW, machine: 8-32 × 3/8"; 8 req'd.
	3-132823	SCREW, tapping: 8-18 × 3/8"; 4 req'd.
	3-135014	SCREW, tapping: 8-18 × 1/2"; 6 req'd.
	15-82433L01	HOOD, door vent

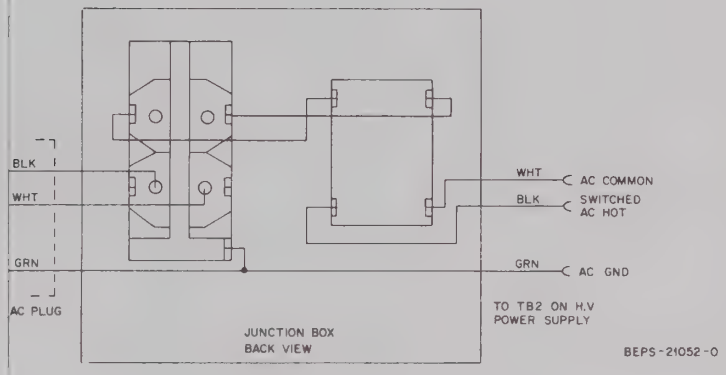
THN6203A Cabinet (75 Inch Outdoor)
Dimensional Detail and Parts List
Motorola No. ***PEPS-21043-A***
12/1/82- UP

POWER JUNCTION BOX

MODELS TRN6587A (60'' INDOOR)
AND TRN5695A (75'' OUTDOOR) OPTIONAL

FUNCTION

Provides ac power inputs to the station.

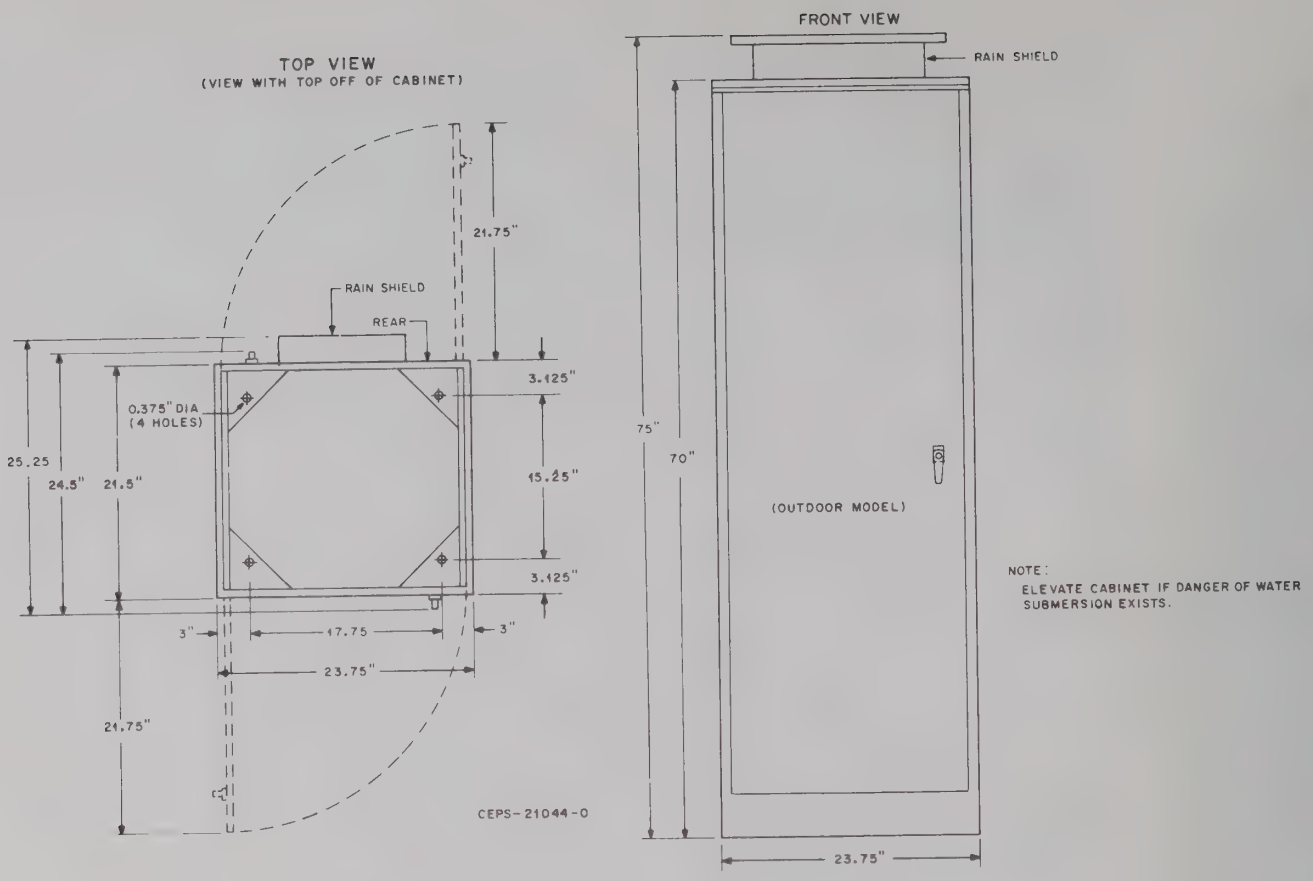


parts list

TRN6587A and TRN5695A Junction Box — PL-4383-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
J1	9-891865	dual ac outlet
		connector, plug:
P1		part of W1
		switch, toggle:
S1	40-82041K01	dpst
		cable:
W1	30-83849E01	ac line cord: includes refer P1 (TRN6587A only)
		mechanical parts
	7-84617H01	BOX, outlet
	15-82025K01	COVER, box; outlet
	29-824154	LUG for #10 lead (TRN6587A only)
	29-845081	LUG for #8 lead (TRN6587A only)
	42-84618H01	CLAMP, cord; 2 req'd.
	64-82314L01	PLATE (TRN6587A only)
	1-80762B68	LEAD ASSEMBLY (GRY-GRN) includes:
	29-848901	LUG, solderless; 2 req'd.
	1-80762B69	LEAD ASSEMBLY (WHT) includes:
	29-848901	LUG, solderless; 2 req'd.
	1-80762B70	LEAD ASSEMBLY includes:
	29-847854	LUG, slotted tongue
	29-848902	LUG, solderless; 4 req'd.

Motorola No. PEPS-21053-A
12/1/82- UP



parts list

THN6203A Cabinet 75" PL-5150-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	15-82123H05	CABINET

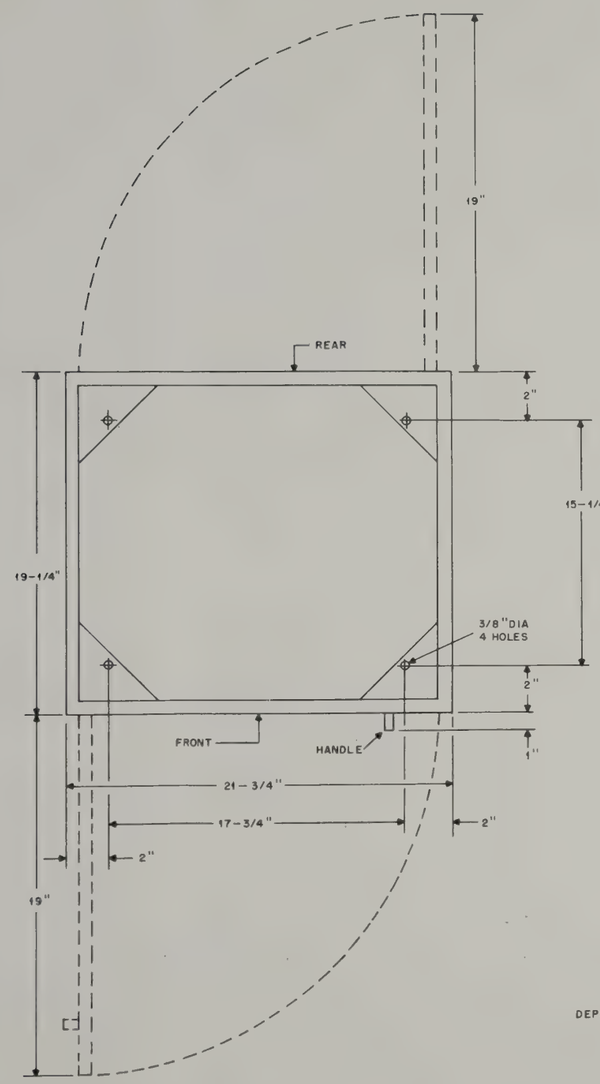
TRN6720A Rain Shield Kit PL-5151-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	26-82929H01	SHIELD, rain (top)
	26-84084F01	SHIELD, cover (top)
	15-82926H01	COVER, rain shield
	32-82499L01	GASKET, rain shield
	32-82499L02	GASKET; rain shield
	32-84180G01	GASKET; 2 req'd.
	32-84180G02	GASKET; 2 req'd.
	2-10080A03	NUT, spring: No. 8; 4 req'd.
	3-9661	SCREW, machine: 8-32 × 3/8"; 8 req'd.
	3-132823	SCREW, tapping: 8-18 × 3/8"; 4 req'd.
	3-135014	SCREW, tapping: 8-18 × 1/2"; 6 req'd.
	15-82433L01	HOOD, door vent

THN6203A Cabinet (75 Inch Outdoor)
Dimensional Detail and Parts List
Motorola No. ***PEPS-21043-A***
12/1/82- UP

TOP VIEW

(VIEW WITH TOP OFF OF CABINET)



DEPS-15048-B

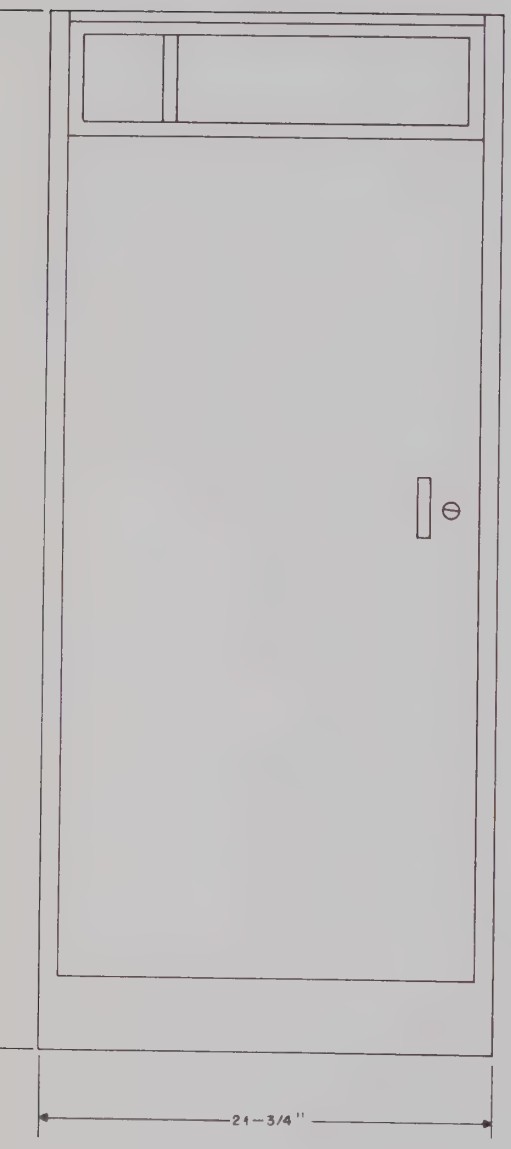
FRONT VIEW

NOTES

1. FRONT AND REAR DOORS CAN BE REVERSED FROM RIGHT HAND OPENING TO LEFT HAND OPENING
2. ON REAR DOOR, UPPER AIR DUCT OPENING MUST BE UNCOVERED AND BOTTOM AIR DUCT OPENING COVERED.
3. ELEVATE CABINET IF DANGER OF WATER SUBMERSION EXISTS

THN6316A (70'' Indoor Cabinet)
Dimensional Detail
Motorola No. ***DEPS-15048-B***
12/1/82- UP

FRONT VIEW

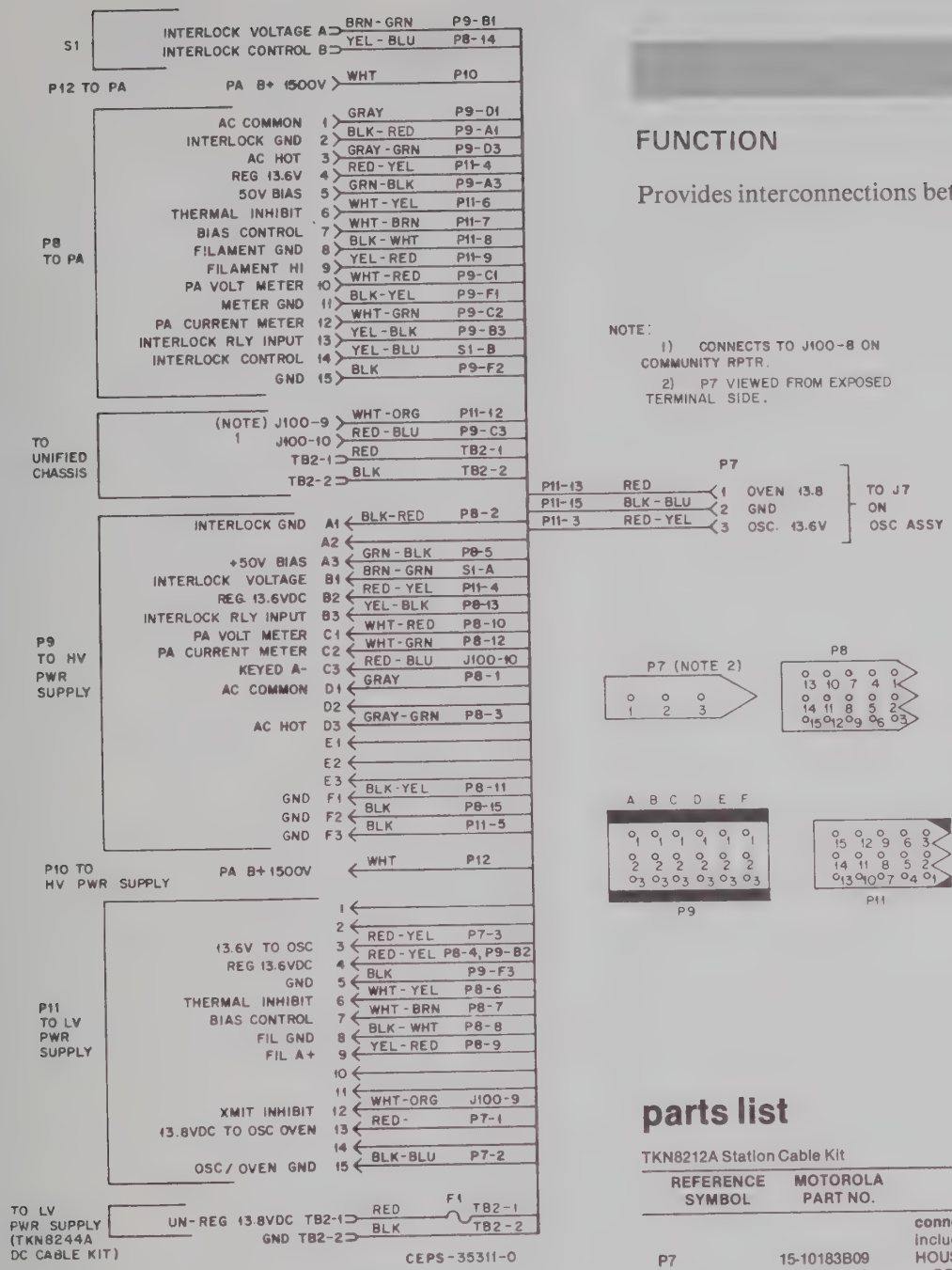


NOTES

1. FRONT AND REAR DOORS CAN BE REVERSED FROM RIGHT HAND OPENING TO LEFT HAND OPENING
2. ON REAR DOOR, UPPER AIR DUCT OPENING MUST BE UNCOVERED AND BOTTOM AIR DUCT OPENING COVERED
3. ELEVATE CABINET IF DANGER OF WATER SUBMERSION EXISTS.

STATION CABLE KIT

MODEL TKN8212A



FUNCTION

Provides interconnections between transmitter boards.

parts list

TKN8244A Cable Fuse — PL-8316-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F1	65-10266	10 amp; 32 V
		mechanical parts
	14-82882A01	BODY, fuseholder
	14-82883A01	CAP, fuseholder
	29-848902	LUG, crimp terminal; 2 used
	29-84078B01	LUG, spade; 2 used
	41-82885A01	SPRING, fuse
	42-10217A02	STRAP, tie; 8 used
	42-82884A01	CLIP, fuse; 2 used

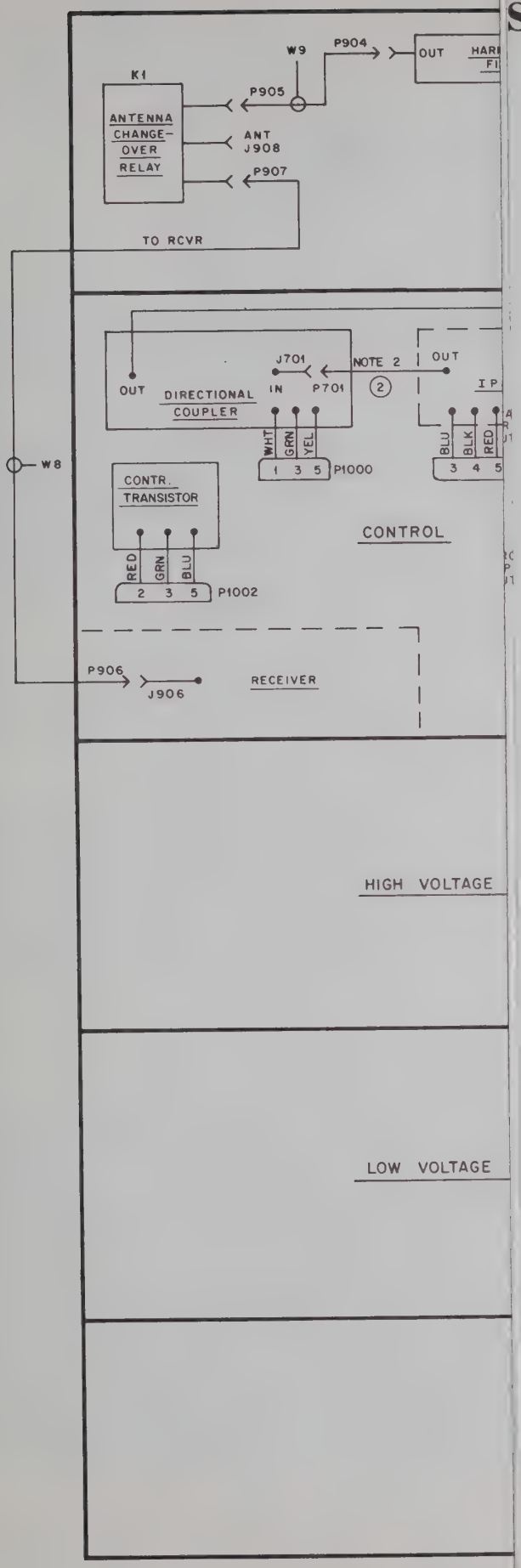
parts list

TKN8212A Station Cable Kit — PL-8190-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, plug: includes:
P7	15-10183B09	HOUSING, 3-contact
	29-84706E06	CONTACT, male; 3 used
P8		includes:
	14-82834H03	INSULATOR; 15-contact
	29-82335A07	CONTACT, female; 15 used
P9		includes:
	14-82337A07	INSULATOR, 11-contact
	29-82335A01	CONTACT, male; 11-contact
	29-82336A01	CONTACT, female; 2 used
P11		includes:
	14-82836H01	INSULATOR; 15-contact
	29-82335A01	CONTACT, male; 10 used
		mechanical parts
	29-83883C06	LUG, soldering; 2 used
	29-84706E06	TERMINAL, crimp socket; 3 used
	30-82905H01	CABLE, high voltage; includes: P10 and P12
	39-10184A24	CONTACT, receptacle; 2 used
	42-10217A02	STRAP, tie (.091 × 3.62 WHT); 27 used
	42-10217A10	STRAP, tie (0.184 × 7.78 WHT); 3 used

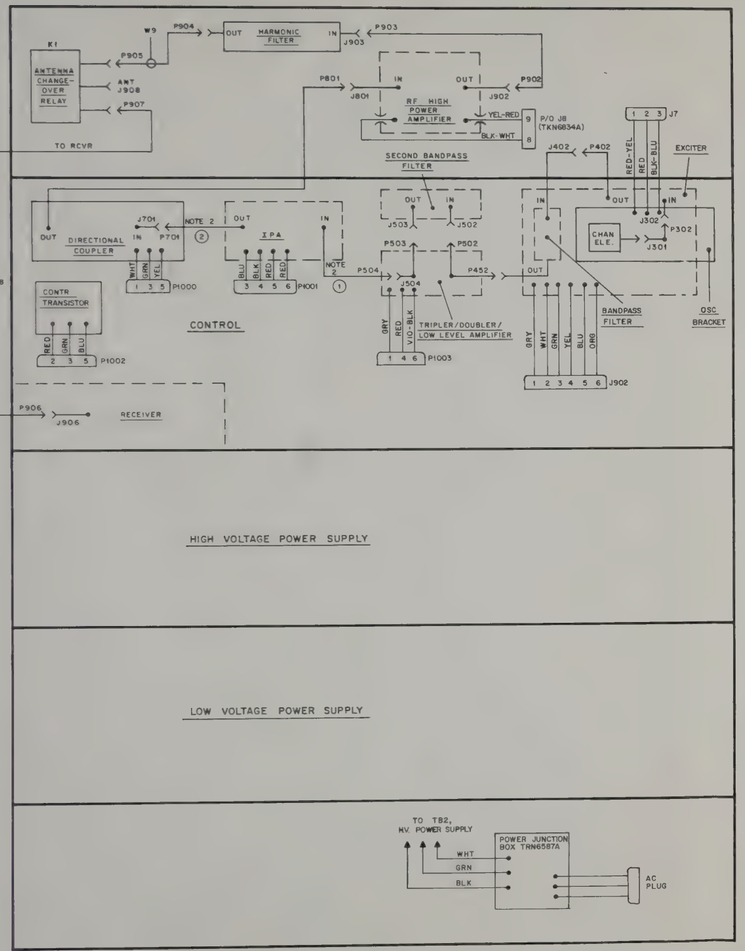
STATION RACKING DIAGRAM CABLING DETAIL & STATION HARDWARE KIT

MODEL TRN4846A



INSTALLATION & INITIAL ADJUSTMENTS

Motorola No. PEPS-35500-O
12/1/82-UP

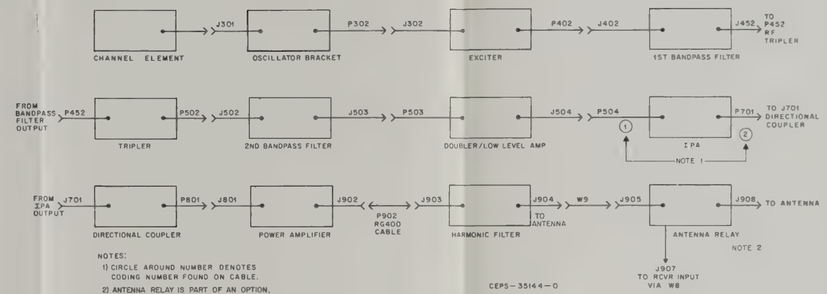


DEPS-35138-O

NOTES:

1. RELAY K1 AND CABLE W8 ARE P/O ANTENNA CHANGEOVER OPTION.
2. CIRCLED NUMBERS INDICATE NUMBERS FOUND ON COAXIAL CABLES.

STATION RF CABLE KIT WIRING DIAGRAM



NOTES:
1) CIRCLE AROUND NUMBER DENOTES CODING NUMBER FOUND ON CABLE.
2) ANTENNA RELAY IS PART OF AN OPTION.

CEPS-35144-O

parts list

TRN4846A Hardware Station (125 W) PL-8205-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		switch:
S1	40-84188A01	interlock
		non-referenced items
	2-119913	NUT, 8-32 x 11/32 x 1/8"; 3 used
	2-82360B34	NUT, speed; 1/4 x 14; 34 used
	3-7506	SCREW, tapping; 6-20 x 1/4"; 2 used
	3-8031	SCREW, machine; 6-32 x 1/4"; 2 used
	3-122777	SCREW, machine; 8-32 x 1/2"; 3 used
	3-134189	SCREW, tapping; 4-40 x 1/4"; 2 used
	3-135038	SCREW, tapping; 14 x 14 x 3/8"; 34 used
	3-138182	SCREW, tapping; 4-40 x 3/8"; 2 used
	3-139495	SCREW, tapping; 6-32 x 5/16"; 2 used
	3-139564	SCREW, cap; 3/8-24 x 1/2"; 2 used
	4-7868	LOCKWASHER, 3/8" external; 2 used
	7-82317L01	BRACKET
	7-83849N01	BRACKET, rack mounting; 2 used
	13-813618	DECAL, patent no.
	14-829003K01	INSULATOR
	26-82911K01	HEAT SINK
	33-84215K03	NAMEPLATE
	42-10217A02	STRAP, tie; .091 x 3.62" WHT; 5 used
	42-10217A10	STRAP, tie; .184 x 7.78; 3 used
	42-84284B01	RETAINER; 2 used
	54-83040C01	LABEL, audio
	54-84126C01	LABEL, replacement parts
	54-84857B01	LABEL, wattmeter
	55-84300B01	HANDLE; 4 used
	55-84300B02	HANDLE
	66-106515	WRENCH, Allen
	66-82186E01	TOOL align.
	26-84981F01	SHIELD
	42-10113A26	RETAINER, ring; 12 used
	46-84090C01	STUD, retainer; 16 used
	26-84053E01	SHIELD and insert
	26-84053E04	INSERT
	26-84278G01	SHIELD, AGC screened
	2-10101A53	NUT, spring; 4 used
	7-82641L02	BRACKET
	45-82842L01	LEVER
	7-82785K02	BRACKET, heat sink
	26-83820K04	SHIELD
	40-84188A01	SWITCH

STATION RACKING DIAGRAM CABLING DETAIL & STATION HARDWARE KIT

MODEL TRN4846A

INSTALLATION & INITIAL ADJUSTMENTS

Motorola No. PEPS-35500-O
12/1/82- UP

STATION MAINTENANCE

1. INTRODUCTION

This section of the manual describes local operation techniques required to perform maintenance checks. Overall station maintenance is detailed in this section while specific chassis maintenance (transmitter, receiver or power supply, etc.) is provided with the applicable section. Maintenance checks for control modules are given with the applicable module in separate Control and Applications Instruction Manual 68P81060E70.

2. LOCAL OPERATION FOR TESTING & MAINTENANCE

NOTE

When ac power to the station is turned on, the transmitter is inhibited by the filament regulator board for approximately 68 seconds. The disable light on the station control module is illuminated during this period. In addition, the synthesizer requires 20 minutes to lock on frequency from initial ac power on.

2.1 Once power is applied and the station is properly adjusted, the station is normally operated entirely unattended from a remote control point. However, the station may be locally operated utilizing controls on control modules in the unified chassis. This type of operation may be necessary to accomplish station maintenance and testing.

2.2 Local operation of the station is primarily accomplished utilizing controls on the station control module located in the unified chassis. The controls and functions are listed in the Station Control Module Controls Table.

WARNING

The transmitter can be keyed remotely. To prevent unexpected transmitter keying while servicing the station, be sure the LINE DISABLE switch is actuated (direction of arrow).

Station Control Module Controls

Control	Position	Functions Possible
XMIT	Normal (not actuated)	Normal mode of operation.
	Actuated (hold-to-right)	Turns on transmitter with no modulation. Use test microphone connected to Local Mic receptacle to modulate transmitter.
PL DISABLE* (functional only in *Private-Line* stations)	Normal (left)	Only PL tone-coded on-frequency signals accepted by receiver.
	Actuated (right)	All on-frequency signals accepted by receiver.
LINE DISABLE*	Normal (left)	Transmitter can be operated by: 1. XMIT switch 2. Local microphone 3. Remote control console
	Actuated (right)	Transmitter *cannot* be operated by remote control console over control line.

* The DISABLE LIGHT is illuminated when the LINE DISABLE or PL DISABLE switch is actuated.

2.3 The following are procedures pertaining to the local operation of a remotely controlled station or repeater station.

2.3.1 Transmitter Control

To prevent the transmitter from being keyed remotely, set station control module LINE DISABLE switch in the direction of the arrow. At conclusion of local operation, insure that the LINE DISABLE switch is returned to its normal position (opposite direction of the arrow).

2.3.2 Local Microphone

2.3.2.1 Stations With Built-In Metering

Connect a Motorola Model (TMN6071A) microphone, or equivalent to the MICROPHONE receptacle on the metering chassis.

2.3.3 Local Speaker

2.3.3.1 Stations Without Built-In Metering

Connect any 8 ohm, 10 watt test speaker to J4, pins 1 and 12 on the unified chassis interconnect board. This speaker is used to monitor all received messages. A Motorola *Micor* speaker (Models TSN6016A or B, TSN6020A) plugs directly into these pins without requiring any adapter.

2.3.3.2 Stations With Built-In Metering

Place the SPEAKER ON-OFF switch to the ON position.

2.3.4 Portable Test Set (For Stations Without Built-In Metering

A Motorola S1056-S1059 Series Portable Test Set with TEK-37 or TEK-37A Adapter Cable can be used as a local control facility. Connect the red "control" plug of the adapter cable to the metering receptacle (J3) on the unified chassis interconnect board. The speaker in the test set can be used for monitoring received signals and a microphone (Model TMN6071A) connected to the microphone receptacle on the test set can be used for originating transmissions. The XMIT button on the test set can be used to key the transmitter without voice modulation.

2.3.5 Received Audio

After the local speaker is turned on or connected, the station is ready to receive audio. The receiver PL feature, if used, can be defeated by setting the station control module PL DISABLE switch in the direction of the arrow. (At the conclusion of local operation, insure that the PL DISABLE switch is returned to its normal position.) If necessary, the receiver can be unsquelched utilizing the receiver SQUELCH control on the receiver chassis. The VOLUME control on the receiver chassis sets the audio output level of the local speaker.

2.3.6 Transmitting

NOTE

Before initiating any local transmissions, monitor the channel to insure that it is clear of other transmissions.

The transmitter is keyed locally by either activating the station control module XMIT switch or activating the push-to-talk microphone switch. Voice is transmitted using the local microphone.

2.3.7 Concluding Local Operation

At the conclusion of local operation, perform the following operations and checks to insure that the station is ready for remote operation.

Step 1. Reset receiver squelch level per procedures in the Receiver Section in the 68P81063E10 Receiver manual.

Step 2. Insure that station control module switches are positioned for normal operation.

Step 3. Disconnect microphone and test speaker (if used).

Step 4. Set all external power switches ON.

Step 5. Insure that station is operable from remote location.

Step 6. Turn local speaker OFF (if applicable).

Step 7. Disconnect or remove any metering plugs or test set.

Step 8. Insure the cabinet doors are locked.

Step 9. Insure that vents in cabinet are unobstructed.

3. MAINTENANCE TECHNIQUES

3.1 GENERAL

Maintenance procedures for individual chassis which comprise this station are contained in the applicable section of this manual. Module maintenance information is provided in separate manual 68P81060E70. As an aid to isolating a malfunction to a specific chassis or module, a variety of techniques are appropriate.

3.2 TRANSMITTER AND RECEIVER

Most troubles in the transmitter or receiver can be quickly isolated with metering checks. A log of normal meter readings *for this station* should be maintained. Each time maintenance is performed, the meter readings should be entered into the log. Variations from the previous readings can isolate a malfunction or may indicate an impending failure. If no previous meter readings are available, typical or minimium meter readings may be found with the Receiver RF and I-F, Exciter, Power Amplifier or Power Control Board instruction sections, as well as metering procedures.

3.3 POWER SUPPLY

A check of power supply voltages under load and no-load conditions (transmit and standby) should quickly isolate any malfunction.

3.4 REMOTE CONTROL UNIT

Isolation of a malfunction in the control portion of the unified chassis requires a functional understanding of the overall station operation and the inter-relationship between the various modules and chassis of the station. The Functional Description section along with the Remote Control Module Diagrams section of manual 68P81060E70 provide necessary information. With a basic understanding of station operation, troubles may be isolated by analyzing the following questions:

1. Are all interlocks working normally?
2. Can the station be operated locally but not remotely? If so, this eliminates many circuits as possible sources of trouble.
3. How many modes are inoperable? Concentrate testing on circuits that are common to the inoperable modes.
4. Are adjustments properly set? This includes audio level adjustments at the station *and at the remote control point.*
5. Are jumpers properly installed? The many jumpers in this equipment provides vast flexibility, but could be a source of trouble if improperly added, removed, or not removed as the case may be.

4. ROUTINE MAINTENANCE CHECK LIST

Item	Check
Receiver	Measure the signal level required to obtain 20 dB quieting.
	Compare meter readings with the minimum value and all previous readings taken. Realign the receiver, if necessary.
	For PL stations, check for proper operation of the PL decoder. Does the squelch open when the proper PL tone or binary code is detected?
Transmitter	Measure transmitter output power.
	Compare meter readings with the minimum value and all previous readings are taken. Realign the transmitter, if necessary.
	Verify that each transmitter channel is on frequency and adjust if necessary.
	Tune and load the transmitter to the antenna.
	Measure transmitter frequency deviation voice, PL coded and digital modulation. Adjust the IDC control, if necessary.
	Measure the exciter modulator sensitivity.
	Check the PA blower filters. Cleaning is required once every six months.
System Operation	Measure and adjust the audio input to the exciter.
	Measure and adjust the receiver(s) audio output to the control line.
	Check control line levels and functions for proper operation.
	Adjust receiver(s) on frequency with the distant transmitter(s) in the system
	Check for proper repeater operation on repeater models.
	Check all accessory equipment for proper operation.
After Performing Maintenance	Check all items listed in the Concluding Local Operation paragraph of this section of the instruction manual.

5. TABLE OF RECOMMENDED TEST EQUIPMENT

Type of Equipment or Type of Measurement	Equipment Characteristics	Recommended Type
Transmitter Frequency Measurement	Frequency: 928-960 MHz Accuracy: ±.00001% or better	Model R1200 Series Service Monitor.
Transmitter Deviation Measurement	Peak reading type for voice or sinusoidal wave; scales for accurate reading of ±5 kHz deviation (and ±1 kHz deviation for *Private-Line* models)	Model R1200 Series Service Monitor.
Transmitter Power Output Measurement	928-960 MHz; 50 ohms; at least 0-250 watts 50 ohm dummy load; at least 150-200 watts	Motorola Wattmeter with appropriate element. Motorola Model T1013 RF Load Resistor.
RF Signal Generator for Receiver Testing	25 to 960 MHz; FM; high-stability; accurate adjustable output 0 to 1000 microvolts	Motorola Model R1200 Series Service Monitor. FM signal generator — equivalent to following specs: Frequency Range: 800 to 960 MHz Calibration Accuracy: 0.25% Stability: ±50 ppm over 15 min. period after 15 min. warmup
Audio Voltage Measurements RF Millivoltmeter	High impedance (10 megohm); dBm scale. Accurate high frequency (up to 800 MHz) voltage measurements at the millivolt level.	Motorola Model S1053 Solid Solid-State AC Voltmeter. Motorola S1339 Analog or S1340 Digital with a 50 ohm BNC adapter tip.
Audio Signal Generator for audio circuit testing in receiver and transmitter	Variable amplitude 0 to 1 volt; 1000 Hz tone (300 to 3000 Hz preferred); sinusoidal wave.	Motorola Model S1067 Solid-State Audio Oscillator. Motorola Model TEK-1 Tone Oscillator. Motorola Model R1200 Series Service Monitor.
DC Voltage Measurements, Resistance Measurements, RF Voltage Measurements.	High impedance (11 megohm) dc multimeter.	Motorola S1063 Solid-State DC Multimeter with SLN6055A RF Probe below 400 MHz; Motorola S1339 RF Millivoltmeter above 400 MHz. Motorola Model R1001 Digital Multimeter.
Waveform Measurements	Oscilloscope: Audio Circuit Measurement. RF Circuit Measurements, at least 50 MHz bandwidth.	Any general purpose oscilloscope. A high quality instrument is required.
Contact Removal Tool	Used to remove female wire terminals from metering cable connector.	Motorola Part No. 66B84690C01.

6. ALIGNMENT

The following paragraphs contain complete transmitter alignment procedures. For convenience, this information is also contained in the applicable section.

NOTE

Before initiating alignment procedures, insure that the filament voltage is properly adjusted (refer to section 68P81031E53).

6.1 EXCITER ALIGNMENT

6.1.1 Excepts From FCC Regulations

FCC Regulations state that:

1. Radio transmitters may be tuned or adjusted only by persons holding a first or second class commercial radiotelephone operator's license or by personnel working directly under their immediate supervision.

2. The power input to the final radio frequency stage shall not exceed the maximum figure specified on the current station authorization. This power input shall be measured and the results recorded:

   - When the transmitter is initially installed.
   - When any change is made in the transmitter which may increase the power input.
   - At intervals not to exceed one year.

3. Frequency and deviation of a transmitter must be checked:

   - When it is initially installed.
   - When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.
   - At intervals not to exceed one year.

6.1.2 Local Transmitter Keying

NOTE
Before initiating any local transmissions, monitor the channel to insure that it is clear of other transmissions.

The transmitter is keyed locally by either activating the station control module XMIT switch or activating the push-to-talk microphone switch. Voice is transmitted using the local microphone.

6.1.3 Frequency Calculations

$$f_o = \frac{f_e}{12} \quad (154.6\text{-}160\ \text{MHz})$$

Where: f_o = oscillator frequency
f_e = exciter output frequency

6.1.4 Transmit Oscillator Frequency Adjustment

6.1.4.1 The transmitter oscillator is either a high stability, ovenized unit employing a warp capacitor for fine frequency adjustment, or a frequency synthesizer. The unit is mounted on the TRN4847A Oscillator Mounting Kit which provides connections to the exciter modulating circuitry.

6.1.4.2 Perform transmit frequency adjustments as follows:

Step 1. Apply power to the station for 15 minutes to allow the oscillator oven to stabilize.

Step 2. Couple a frequency counter with a time base of at least 0.1 ppm to the PA output. Attach test equipment as indicated in Figure 1.

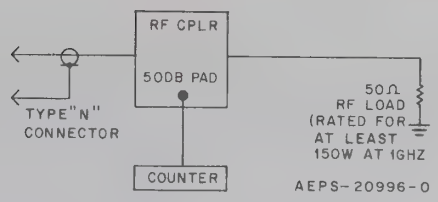


Figure 1. Frequency Adjust Equipment Setup

Step 3. Remove the silver colored plug (labeled FREQ ADJUST) from the end of the oscillator.

Step 4. Using a tuning tool, adjust the screw behind the silver plug until the frequency registered on the counter matches the specified rf carrier frequency.

Step 5. Replace the silver plug and remove all test equipment.

6.1.5 Deviation (IDC) Adjustment

Step 1. It is assumed that the transmit channel has been "warped" on frequency before attempting to adjust the IDC circuit.

Step 2. Connect an audio oscillator to the exciter input (pin 12, accessible from front of station behind exciter cover).

Step 3. Set the audio oscillator for 1000 Hz @1 volt (rms).

Step 4. Key the transmitter and adjust the IDC control for ±5 kHz deviation.

Step 5. Reduce the audio oscillator output to 0.25 volts. Essentially, full deviation should still be indicated. Less than full deviation may indicate weak or inoperative exciter audio stages.

Exciter Alignment Procedure

Step	Adjust	Metering Plug Location	Selector Switch Position	Meter Rev. Switch and Ref A-B Switch (See Note)	Stage and Procedure
1					SET UP — Key the transmitter with the XMTR ON pushbutton on the portable test set.
2	POWER SET				OUTPUT — Turn the POWER SET control fully counterclockwise. Unkey the transmitter.
3	FREQUENCY SWITCH	EXCITER	2	OFF REF A	CHANNEL ELEMENT — Select the desired frequency on multi-frequency stations. Key the transmitter. The test set meter 2 should indicate at least 10 uA.
4	ALL EXCITER COILS	EXCITER	5	OFF REF A	PRE-ALIGNMENT — If the exciter is completely untuned and shows no meter 5 readings, set cores of tuning coils L401 to L406 to the top of their coil forms (away from circuit board). Set cores of L407 and L408 per the exciter pre-tuning chart. If a meter 5 reading is available proceed to Step 7.
5	L401	EXCITER	2	OFF REF A	BUFFER OUTPUT — Tune L401 for minimum meter reading.
6	L401, L402	EXCITER	3	OFF REF A	BUFFER OUTPUT — Tune L402 and then L401 for peak meter reading.
7	L403	EXCITER	3	OFF REF A	TRIPLER OUTPUT — Tune L403 for minimum meter reading.
8	L403, L404	EXCITER	4	OFF REF A	TRIPLER OUTPUT — Tune L404 and then L403 for peak meter reading.
9	L405	EXCITER	4	OFF REF A	FIRST DOUBLER OUTPUT — Tune L405 for minimum meter reading.
10	L405, L406	EXCITER	5	OFF REF A	SECOND DOUBLER OUTPUT — Tune L406, and then L405 for peak meter reading.
11	L407, L408	EXCITER	5	OFF REF A	EXCITER OUTPUT — Tune L407 then L408 for peak meter reading.
12	L407, L408	PA	1	METER REV REF A	EXCITER OUTPUT — Move the metering plug to the PA. Tune L408 and then L407 for peak meter reading.
13					Repeat Steps 6, 8 and 10.
14					Align the power amplifier.

NOTE

Metering may be performed using either optional built-in meter (if so equipped) or by using a Motorola S1056 thru S1059 Series Portable Test Set. All meter readings are based on a 2000 ohm equivalent series resistance in the meter. Therefore, meters not having a 2000 ohm series resistance must have their readings corrected. The following Exciter Alignment Procedure is written to cover all three cases. The OSC. & METER REV. SWITCH column refers to portable test set usage — polarity is automatically reversed as required when built-in metering is used.

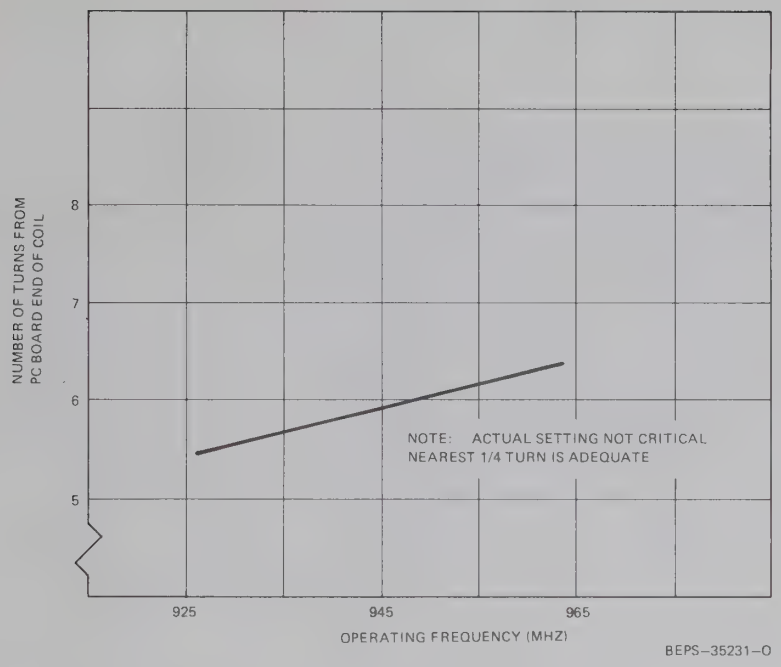


Figure 2. Tuning Preset for Exciter Coils

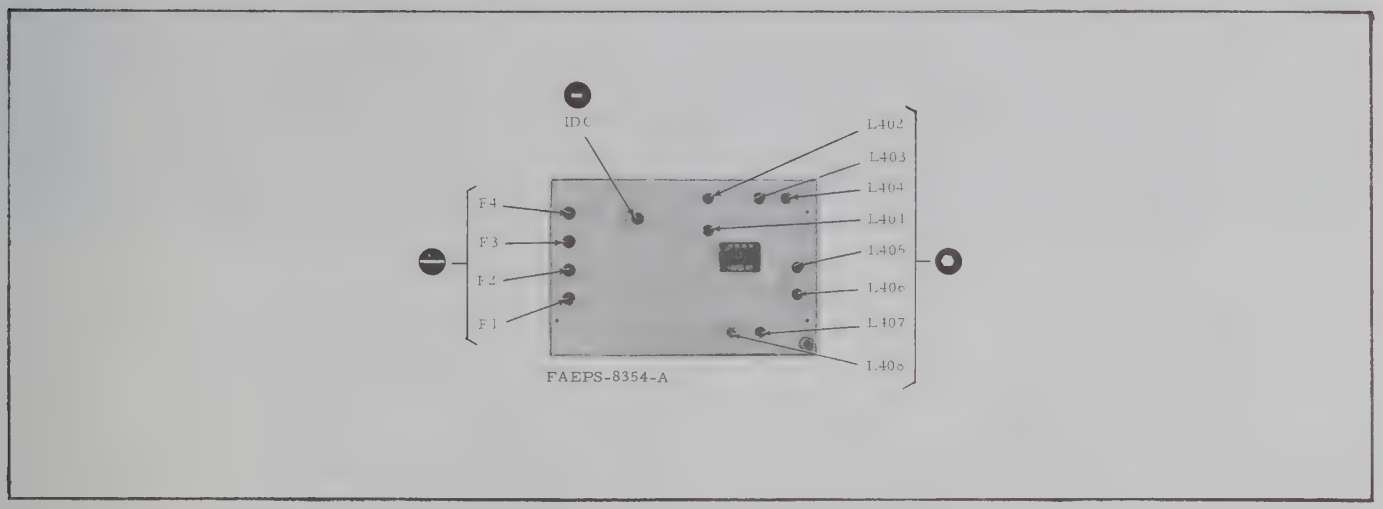


Figure 3. Exciter Adjustment Locations

6.2 IPA POWER SETTING PROCEDURE

NOTE

If the transmitter is to be brought back up to rated power after turning down the POWER SET control for alignment or troubleshooting procedure, proceed directly to Step 4.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
1	Power Set and Drive	Power Control Board	Wattmeter		Pre-Setting of Controls: Adjust the drive limit control fully counterclockwise (maximum drive). Adjust the Power Set Control fully clockwise (near maximum power output). Connect a wattmeter and load to the directional coupler rf output connector and remove the shelf from over the power control board.
2	Drive Limit	Power Control Board	Wattmeter		Key Transmitter. Adjust drive limit (R609 on power control board) until a power output of 20 watts is obtained. If power output is less than 20 watts, see IPA, and power control board maintenance sections. Unkey the transmitter and replace shield.
3	Power Set	Power Control	Wattmeter		Key the transmitter. Adjust the power set control (R607 on power control board) until power output is within the station licensing parameters. Unkey the transmitter. On multi-frequency radios, check drive limit on both channels. If necessary, readjust Drive Limit control so the lowest power channel is set to 20 watts. If the Drive Limit control cannot obtain a high enough reading, set it fully counter-clockwise (minimum drive limit). Unkey transmitter.
4	Power Set	Power Control Board	Wattmeter		Power Set: Key transmitter. Adjust the power set control ccw and set power output per Table 5 under Power Set. On multi-frequency radios, check power output on all channel. If necessary, readjust Power Set so the lowest power channel is set per Table 5 under Power Set. Unkey transmitter. This completes the IPA power setting procedure.
5	Filament Voltage	P.A.	Voltmeter		Verify standby filament voltage of 6.3 V dc. Key exciter - IPA and verify that filament voltage drops to 4.7 V dc. Readjust as necessary with controls located on the power supply regulator board.

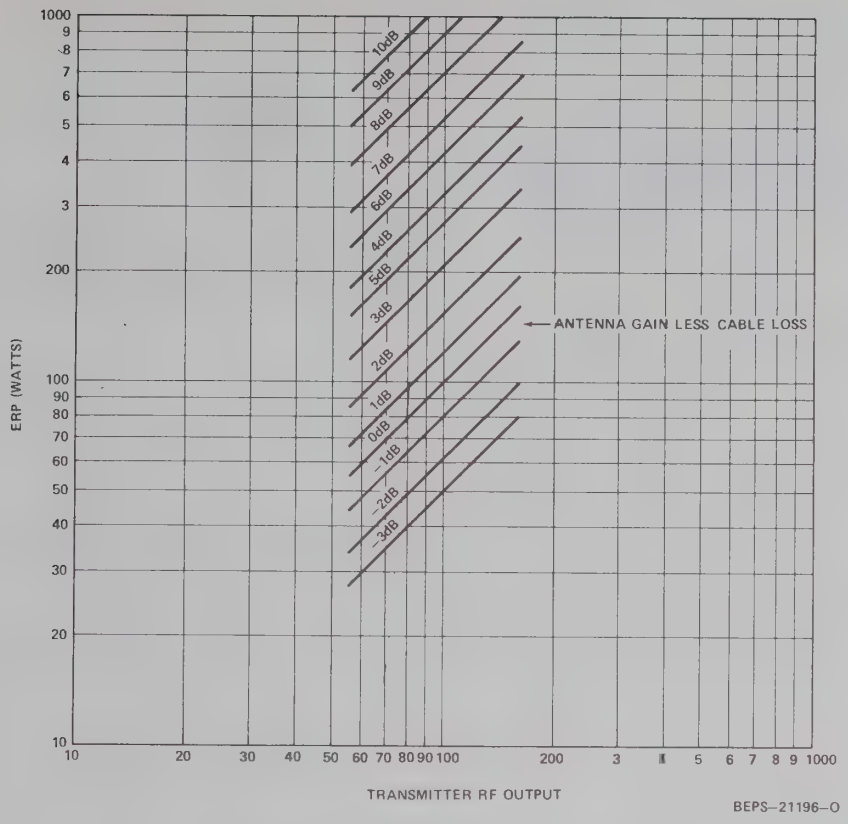


Figure 4. Effective Radiated Power

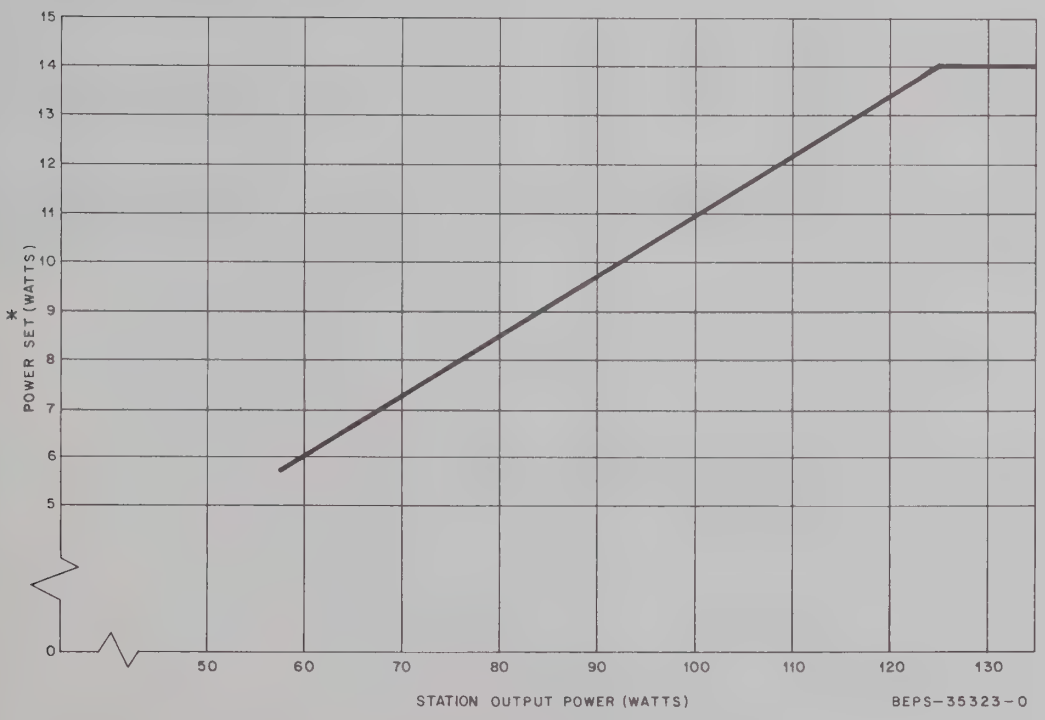


Figure 5. IPA Power Output

6.3 FINAL PA ALIGNMENT PROCEDURE

CAUTION

High voltages are present when power is applied to the station.

6.3.1 Preliminary Adjustment

Step 1. Insure that no ac power is applied to the station.

Step 2. Before attempting to align the power amplifier, insure that the exciter, IPA, and low voltage power supply adjustments have been made.

Step 3. Connect a 250 watt wattmeter between the antenna output connector and the antenna.

Step 4. Loosen locking screws on the output coupling, output fine tuning, input coupling, and input line tuning controls.

Step 5. Set the controls on amplifier as indicated below. (See Figure 1.)

- OUTPUT TUNING CONTROL — Fully ccw (as looking down on the cavity) or control knob fully extended out.
- PLATE CURRENT CONTROL — Fully ccw.
- OUTPUT COUPLING CONTROL — Fully ccw (as looking down on cavity) or control knob fully in.

Step 6. Tighten down *all* screws on power amplifier cavity, front and rear. This step is important to insure proper operation of the cavity.

6.3.2 TUNING PROCEDURE

After making preliminary adjustments, perform the following tuning procedure.

Step 1. Apply power to the station. After the transmitter is enabled by the transmit inhibit circuitry (see section 68P81031E53 in the Power Supply section), key the station. Slide the coarse input coupling control in and out. Observe the best dip on power control meter 2 reading.

NOTE

The dip can be very sharp, so move the control very slowly in small amounts.

Step 2. Alternately turn the input coupling and input tuning controls for minimum reflected power (power control meter 2).

Step 3. Alternately turn the output coupling and output tuning controls for maximum power output.

Step 4. Increase the plate current adjustment control to achieve approximately 300 mA or 125 W output, whichever comes first.

Step 5. Adjust the input tuning and input coupling controls to minimum power control meter 2 reading.

Step 6. Adjust output tuning and output coupling controls for maximum power output. Continue adjustments until no further improvement can be obtained.

Step 7. Adjust the plate current control to achieve 125 W output from the station.

Step 8. Tighten down the output coupling and tuning controls and then the input coupling shaft and tuning control.

OSCILLATOR MOUNTING KIT

MODEL TRN4847A, F1

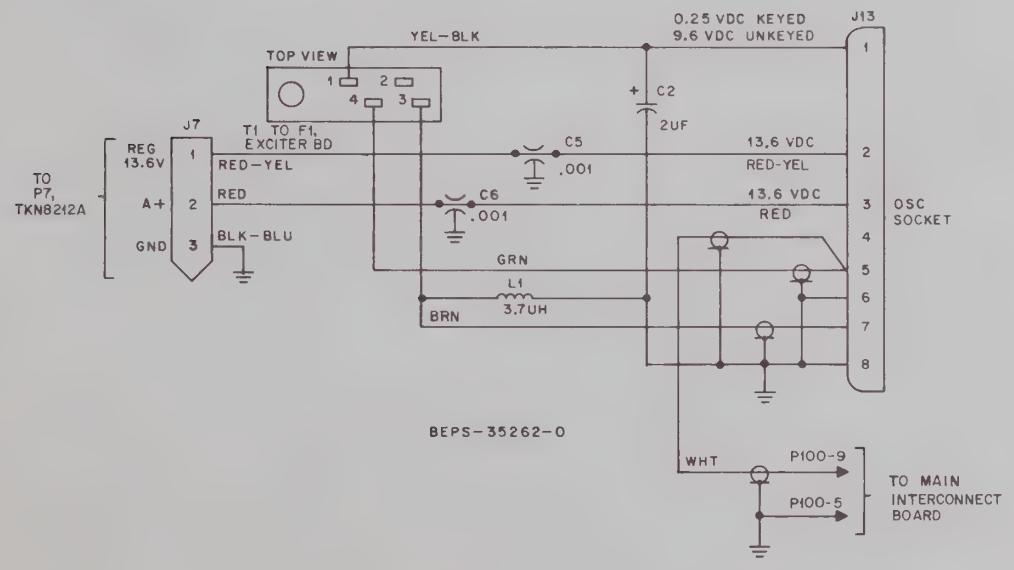
parts list

TRN4847A Oscillator Mounting Kit — PL-8166-O

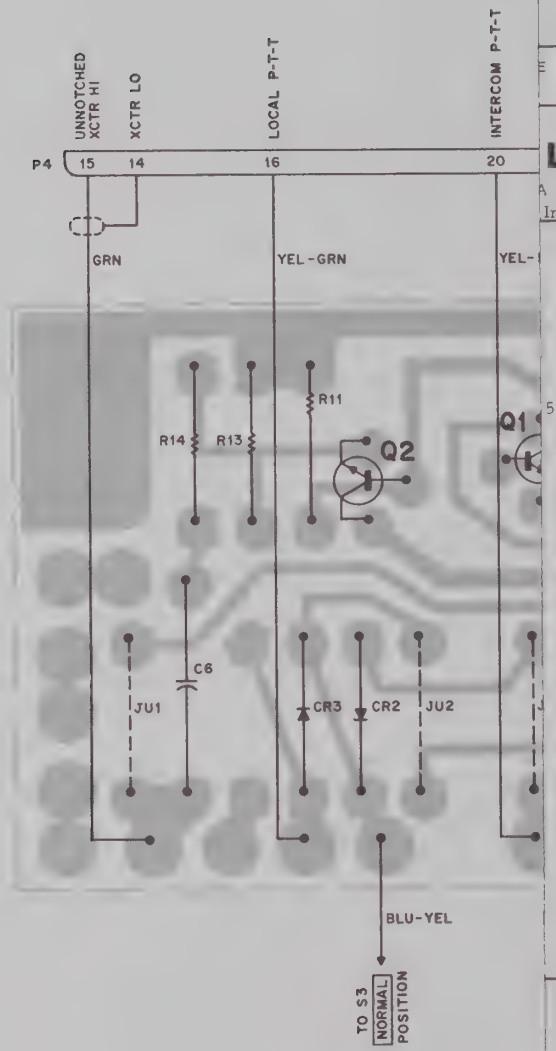
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C2	23-82601A34	2 uF + 150-10%; 25 V
C3, 4		NOT USED
C5, 6	21-861219	.001 uF + 100-0%
		coil, rf:
L1	24-82835G21	3.7 uH
		connector, receptacles:
J7	15-10183B12	housing; 3 contact
		connector, plug:
P13	9-6740	socket, 8 contact
		mechanical parts
	1-80761D64	ASSEMBLY, oscillator; includes:
		ref. items C5, 6 and;
	4-83755H01	WASHER, shoulder; 2 used
	7-82393N01	BRACKET, oscillator
	42-82393N01	CLIP
	1-80791B45	ASSEMBLY, oscillator cable; includes:
		ref. items J7, P13, and;
	9-83208C02	SOCKET, channel element
	26-83193C06	SHIELD, channel element
	30-824274	WIRE, shield; GRN; 8" used
	30-859004	CABLE, coaxial; RG188/U; 9" used
	37-109120	GROMMET, rubber
	42-10217A02	STRAP, tie
	2-114043	NUT, 4-40 x 3/16 x 1/16"; 2 used
	3-2950	SCREW, machine; 4-40 x 1/4"; 2 used
	3-136891	SCREW, tapping; 4-24 x 1/4"; 4 used
	15-82427N01	COVER, oscillator
	29-84706E05	TERMINAL, crimp; 3 used
	30-83794C01	COAX CABLE, 12 inches
	39-10184A24	RECEPTACLE CONNECTOR; 2 used
	42-82143C09	CLIP

FUNCTION

The oscillator mounting kits are assemblies used to facilitate external mounting of a highly stable oscillator.



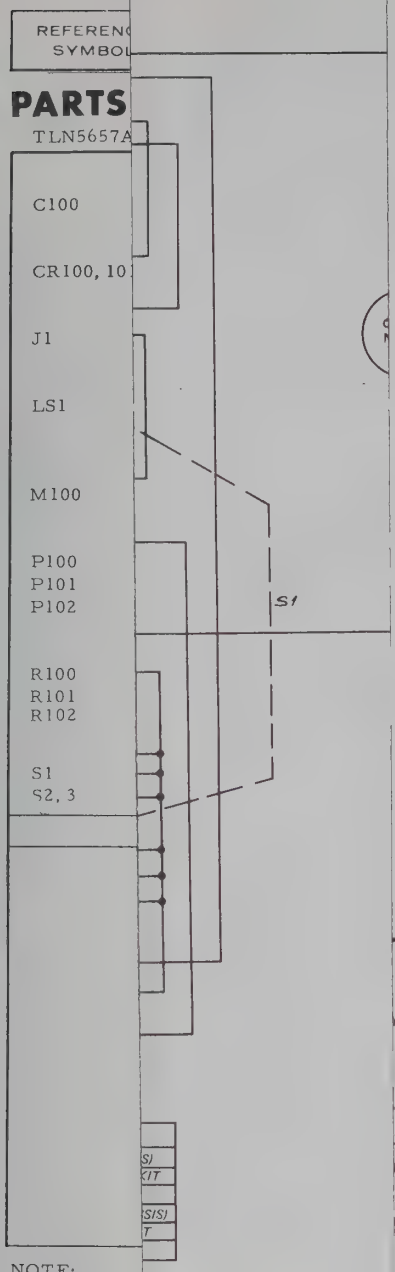
METERING & INTERCOM



LIST

A Meter Chassis & Intercom Kit
Intercom Board PL-2156-C

	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF;
	8-82905G11	0.22 ±10%; 50 V
	23-865137	4.7 ±20%; 25 V
	8-82905G11	0.22 ±10%; 50 V
	23-865137	4.7 ±20%; 25 V
		SEMICONDUCTOR DEVICE, diode:
5	48-83654H01	silicon
		SWITCH, magnetic reed: 13.4 V dc
	80-84157B02	dual-coil; 2 form "A", 1 form "B"; resistance of each coil 285 ohms ±10%
		TRANSISTOR:
	48-869642	NPN; type M9642
		RESISTOR, fixed: ±10%; 1/4 W;
	6-124C69	6.8k
	6-124C51	1.2k
	6-124C53	1.5k
	6-124C43	560
	6-124C49	1k
	6-124C69	6.8k
	6-124C83	27k
	6-124C93	68k
	6-124C43	560
	6-124C19	56
	6-124C85	33k
	6-124C75	12k
	6-124C49	1k
	6-124C45	680



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"COMPA-STATION" METERING & INTERCOM

MODEL TLN1740A

INTERCOM

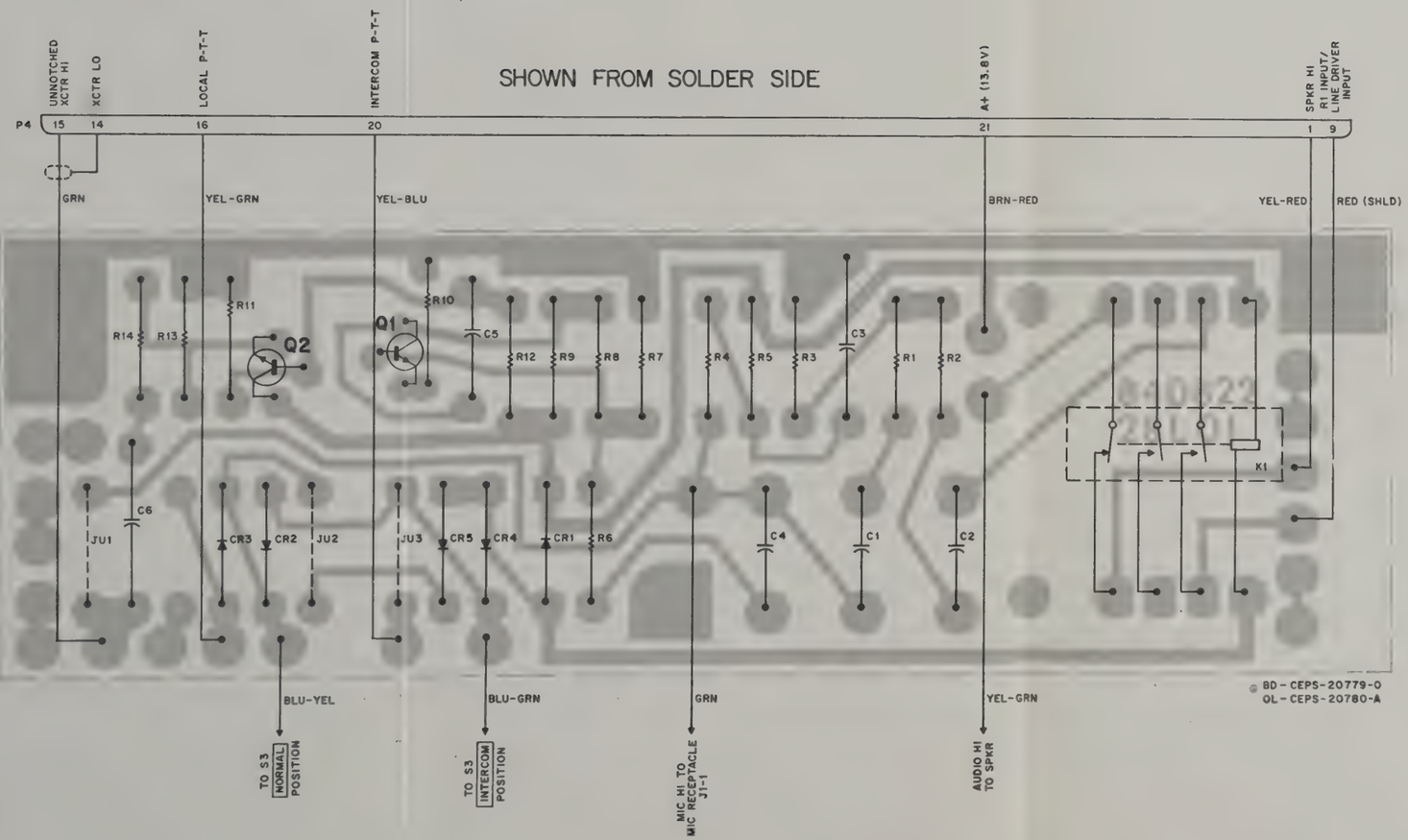
MODEL TLN1745A

FUNCTION

--Model TLN1740A provides built-in metering of over 20 major test points in the transmitter and receiver(s), plus intercom between the station and the remote control point.

--Model TLN1745A provides intercom between the station and the remote control point.

METERING & INTERCOM



REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN1552A Meter Chassis & Intercom Kit
TLN5167A Intercom Board PL-2156-C

		CAPACITOR, fixed: uF:
C1,2	8-82905G11	0.22 ±10%; 50 V
C3	23-865137	4.7 ±20%; 25 V
C4,5	8-82905G11	0.22 ±10%; 50 V
C6	23-865137	4.7 ±20%; 25 V
		SEMICONDUCTOR DEVICE, diode:
CR1 thru 5	48-83654H01	silicon
		SWITCH, magnetic reed: 13.4 V dc
K1	80-84157B02	dual-coil; 2 form "A", 1 form "B"; resistance of each coil 285 ohms ±10%
		TRANSISTOR:
Q1,2	48-869642	NPN; type M9642
		RESISTOR, fixed: ±10%; 1/4 W:
R1	6-124C69	6.8k
R2	6-124C51	1.2k
R3	6-124C53	1.5k
R4	6-124C43	560
R5	6-124C49	1k
R6	6-124C69	6.8k
R7	6-124C83	27k
R8	6-124C93	68k
R9	6-124C43	560
R10	6-124C19	56
R11	6-124C85	33k
R12	6-124C75	12k
R13	6-124C49	1k
R14	6-124C45	680

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

PARTS LIST

TLN5657A Meter Kit PL-3415-A

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		CAPACITOR, fixed:
C100	21-82428B24	.01 uF +80-20%; 500 V
		DIODE: (SEE NOTE)
CR100, 101	48-82420C03	silicon
		CONNECTOR, receptacle:
[illegible]	9-830418	4-contact
		LOUDSPEAKER; permanent:
LS1	50-84710G01	dynamic type; 3"; square 16 ohms voice coil impedance
		METER, dc:
M100	72-83120C02	scale: 0-50 microamperes
		CONNECTOR, plug:
[illegible]	29-82676C01	test probe; BLACK
[illegible]	29-82676C02	test probe; RED
[illegible]	28-84208B01	7-contacts
		RESISTOR, fixed:
[illegible]	6-84640C61	499k ±0.5%; 1/4 W
[illegible]	6-13756D88	100k ±1%; 1/2 W
[illegible]	6-124A33	220 ohm ±5%; 1/4 W
		SWITCH:
[illegible]	40-83158C01	rotary; 2 section
[illegible]	[illegible]	slide; dpdt
NON-REFERENCED ITEMS		
	5-483208	GROMMET
	35-84530G01	GRILLE, speaker
	36-84356C01	KNOB, control
	42-10217A02	STRAP, cable; 4 req'd.
	42-82143C02	CLAMP, cable
	15-83947K01	COVER; 2 req'd. (used with P102)
	30-83678K01	CABLE, 7-conductor; 42" long (used with P102)
	42-83948K01	CLIP; 2 req'd. (used with P102)
	27-83008K01	CHASSIS, meter
	31-490181	TERMINAL STRIP, 1-lug
	42-871184	CLIP, probe; 3 req'd.
	15-83009K01	COVER, meter
	42-83123F01	RETAINER, nylon; 2 req'd.
	75-838826	BUMPER, rubber; 4 req'd.

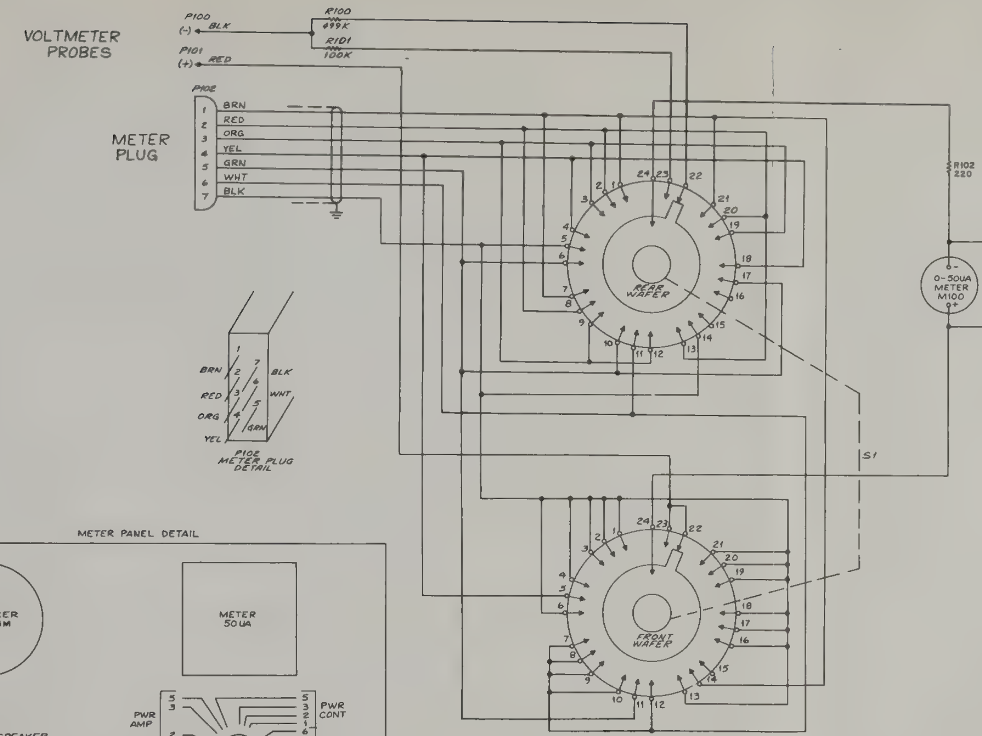
NOTE:
For optimum performance, replacement diodes must be ordered by Motorola part number.

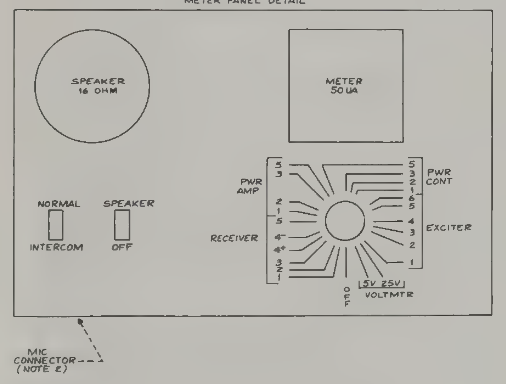
TRN6189A Intercom Chassis Kit PL-3452-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CONNECTOR, receptacle:
J1	9-830418	4-contact
		SPEAKER
LS1	50-84710G01	3 ; 16 ohm
		RESISTOR, fixed; ±10%:
R103	17-82177B55	8; 7 W
R104	17-82177B44	13; 15 W
		SWITCH, slide:
S2, 3	40-11589	spst
NON-REFERENCED ITEMS		
	1-80775B59	CHASSIS (riveted) incl. ref. item S2 and S3
	1-80775B51	COVER ASSEMBLY
	2-132616	LOCKNUT, speaker (No. 6-32) 4 req'd.
	2-83896G01	NUT, hex (used with J1)
	4-7699	LOCKWASHER (used with J1)
	5-483208	GROMMET, rubber
	35-84530G01	GRILLE, speaker
	42-82143C02	CLAMP, cable (1/4")
	42-10217A02	TY-WRAP, cable; 4 req'd.
	3-134169	SCREW, machine: No. 4-40 x 1/4"; 7 req'd.
	3-129498	SCREW, machine: No. 6-32 x 5/16"; 4 req'd.
	29-115147	LUG, solder (No. 5)
	31-823389	TERMINAL, strip; 2 used

TKN6780A Cable Kit PL-3418-A

		CONNECTOR:
P4	-	includes:
	9-84151B03	CONTACT, receptacle; 10 req'd
	14-84556B02	HOUSING
NON-REFERENCED ITEM		
	42-10217A02	STRAP, cable harness; 7 used





METER SELECT TABLE

P102 METERING PLUG CONNECTED TO	METER SELECTOR SW. MTR NO.		POSITION	FUNCTION METERED	
RCVR RF & I-F BOARD	RECEIVER	1	1	CHANNEL ELEMENT OUTPUT (3RD HARMONIC)	
		2	2	1ST DOUBLER OUTPUT	
		3	3	2ND DOUBLER OUTPUT	
		4 (+)	4	DISCRIMINATOR OUTPUT	
		4 (–)	5	DISCRIMINATOR OUTPUT	
		5	6	LIMITER OUTPUT	
POWER AMPLIFIER	POWER AMP (NOTE 2)	1	7	PRE DRIVER CURRENT	
		2	8	25 W DRIVER CURRENT (75 W MODELS ONLY)	
		3	9	FINAL AMPLIFIER CURRENT (EXCEPT 12 W STATIONS)	
		5	10	CONTROLLED (ADL) STAGE VOLTAGE	
POWER CONTROL BOARD	PWR CONT (NOTE 2)	5	11	FINAL AMPLIFIER CURRENT (12 W STATIONS ONLY)	
		3	12	ADL VOLTAGE	
		2	13	REFLECTED POWER	
		1	14	FORWARD POWER	
– –	– –	–	15	UNUSED	
EXCITER	EXCITER	6	16	UNUSED	
		5	17	EXCITER OUTPUT	
		4	18	DOUBLER INPUT	
		3	19	TRIPLER INPUT	
		2	20	CHANNEL ELEMENT OUTPUT	
		1	21	"IDC" AUDIO OUTPUT	
– –	– –	–	22	25 VOLTS FULL SCALE	(NOTE METER IS LABELED 0–50)
– –	– –	–	23	5 VOLTS FULL SCALE	
– –	– –	–	24	OFF	

MODEL COMPLEMENT TABLE

MODEL	CONSISTS OF	
TLN1740A METERING & INTERCOM KIT	TLN5657A -1	METER KIT (CHASSIS)
	TLN5167A -1	INTERCOM BOARD KIT
	TKN6780A	CABLE KIT
TLN1745A INTERCOM KIT	TRN6189A	INTERCOM KIT (CHASSIS)
	TLN5167A -1	INTERCOM BOARD KIT
	TKN6780A	CABLE KIT

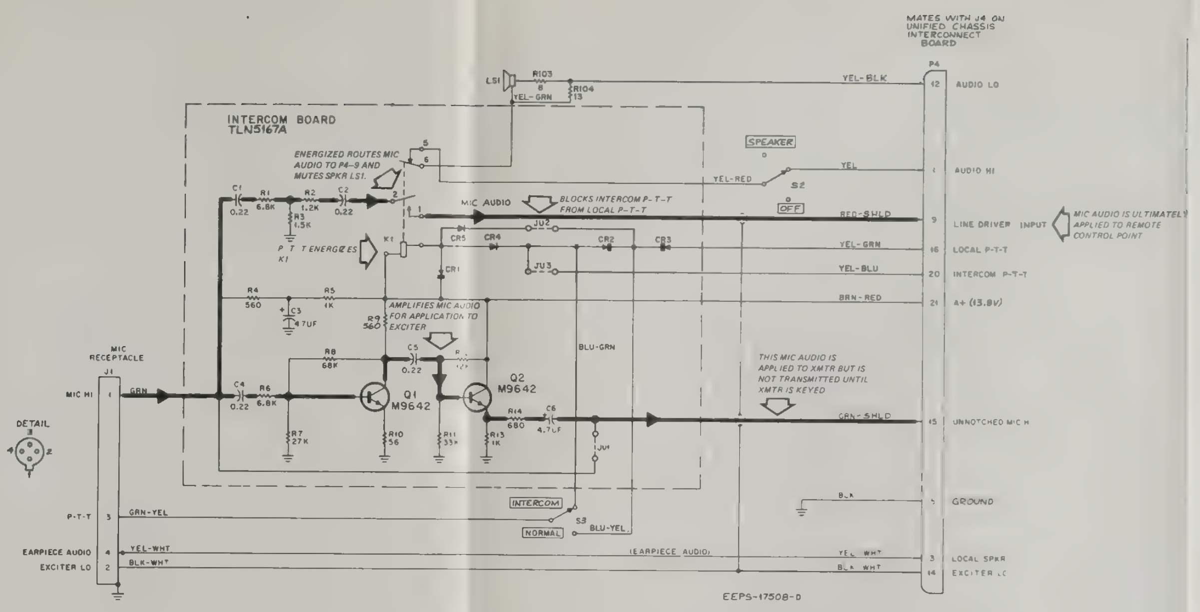
NOTES

1. THIS OPTION REQUIRES THE USE OF A MOTOROLA MODEL TMN6071A MICROPHONE, OR EQUIVALENT
2. WITH 12 W STATIONS, FINAL PA CURRENT IS METERED AT PWR CONT MTR 5. WITH ALL OTHER STATIONS, FINAL PA CURRENT IS METERED AT PA MTR 3.

JUMPER TABLE

JUMPER	NORMAL	WHEN "SPECTRA TAC" IS ADDED (CUT CR2)
JU1	OUT	OUT
JU2	OUT	IN
JU3	OUT	IN

LEGEND:
THEORY NOTE
PRIMARY SIGNAL FLOW



OPERATING INSTRUCTIONS

1. METERING

Step 1. Select the function to be metered with the METER switch.

Step 2. Select the chassis to be monitored by placing the metering plug (P102) into the metering receptacle of the receiver, exciter, power control board or the power amplifier.

NOTE
Metering plug P102 should be plugged in only when tuning. Unplug it when it is not being used.

Step 3. For receiver discriminator adjustment, use both 4(+) and 4(—) and adjust for meter zero.

Step 4. Refer to the Transmitter and Receiver sections of this manual for typical or minimum readings. Better yet, keep a log of all meter readings each time the station is serviced. Use the last set of readings as a reference and note any degradation in performance.

Step 5. To measure miscellaneous station voltages, use the voltmeter probes (P100 and P101) on either the 5 V or 25 V positions. Divide the 5 V full scale reading by 10 to obtain actual voltage and divide the 25 V full scale reading by 2 to obtain actual voltage.

2. INTERCOM

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the INTERCOM position.

Step 4. The unit is now ready for intercom operation between the station and the remote control point. Close the PUSH-TO-TALK switch on the microphone and speak into the microphone to send a message. Release the button to listen; replies will be heard in the speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

Step 5. Return the SPEAKER-OFF switch to the OFF position before leaving the station unattended.

3. "ON-THE-AIR" TESTING

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the NORMAL position.

Step 4. The unit is now ready for "ON-THE-AIR" testing. If the microphone PUSH-TO-TALK switch is closed, the station's transmitter will be keyed. Speak into the microphone to transmit a message. Release the PUSH-TO-TALK switch to listen. Receiver audio will be heard on the speaker.

Step 5. Return the SPEAKER-OFF switch to OFF before leaving the station unattended.

4. MONITORING

To monitor audio quality, etc., place the SPEAKER-OFF switch in the SPEAKER position. Both receiver audio and line audio from the remote control point will be heard in the speaker.

"COMPA-STATION" METERING & INTERCOM

MODEL TLN1740A

INTERCOM

MODEL TLN1745A

FUNCTION

--Model TLN1740A provides built-in metering of over 20 major test points in the transmitter and receiver(s), plus intercom between the station and the remote control point.

--Model TLN1745A provides intercom between the station and the remote control point.

Motorola No. PEPS-17760-E
(Sheet 2 of 3)
9/1/80 UP

PARTS LIST

TLN5656A Metering Kit — PL-3416-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		DIODE: (SEE NOTE)
CR1	48-82392B03	silicon
		CONNECTOR, receptacle:
J1	9-830418	4-contact
		TRANSISTOR: (SEE NOTE)
Q1	48-869571	PNP; type M9571
		CONNECTOR, plug:
P100	29-82676C01	test probe; BLACK
P101	29-82676C02	test probe; RED
P102	28-84208B01	7-contact
		RESISTOR, fixed: ±10%; 1/2 W unless otherwise stated
R1		NOT USED
R2	17-82177B04	5; 5 W
R3	6-124A33	220
R4, 10	6-84640C61	499k ±1%
R5	6-125C17	47
R6	6-124A77	15k ±5%; 1/4 W
R7	6-124A57	2.2k ±5%; 1/4 W
R8	6-125C15	39
R9	6-125A39	390
R11	6-12756D88	100k ±1%
R12	6-125A33	220 ±5%
		SWITCH:
S1	40-83158C01	rotary; 2 section
S2, 3	40-83890A01	slide; dpdt
S4	40-811751	toggle; dpdt
NON-REFERENCED ITEMS		
	42-890499	CLAMP, cable; 1/2"
	36-82630H01	KNOB, control
	31-490181	TERMINAL STRIP, 1-lug; 2 req'd.
	42-871184	CLIP, probe; 3 req'd.
	30-83678K01	CABLE, 7-conductor; 57" long (used with P102)
	15-83947K01	COVER; 2 req'd. (used with P102)
	42-83948K01	CLAMP, cable; 2 req'd.
	31-835961	TERMINAL BOARD, 18-lug
	27-83400K01	CHASSIS

NOTE:
For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

TKN6782A Cable Kit — PL-3417-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CONNECTOR:
P4		includes
	9-84151B03	CONTACT, receptacle; 12 req'd.
	14-84556B02	HOUSING

TLN5134A Meter Panel — PL-2233-A

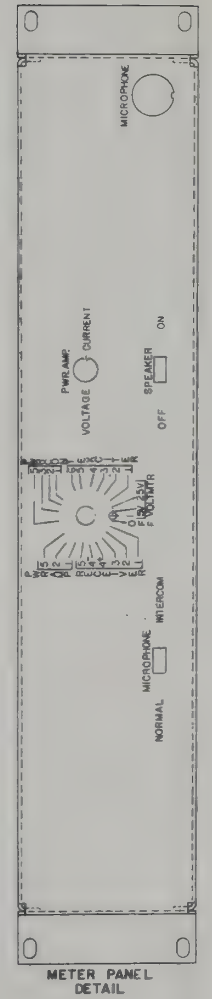
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		LIGHT, indicator:
DS1	65-83183G02	includes lamp and GRN lens
DS2	65-83183G04	includes lamp and RED lens
		LOUDSPEAKER, permanent magnet:
LS1	50-83562A01	dynamic type; 4"; square; 4 ohms voice coil impedance
		METER, electrical: 50 uA movements:
M1	72-84864B10	scale: 0-25 volts/amps
M2	72-84864B09	scale: 0-50 microamperes
NON-REFERENCED ITEMS		
	13-84616G01	GRILLE, speaker
	13-83207F01	CLOTH, speaker grille
	42-83112A01	CLIP, indicator light retaining; 2 used
	2-7009	NUT, hex: 10-32 x 3/8 x 1/8"; 4 used
	3-119916	SCREW, machine: 10-32 x 7/16" 4 used
	3-131964	SCREW, tapping: 6-32 x 3/8; 12 used
	4-7658	WASHER, lock: #10 (split); 4 used
	7-84620G01	FRAME, top
	7-84620G03	FRAME, bottom
	7-84620G05	FRAME, end: 2 used
	13-83054C10	GRILLE, meter panel
	64-83152C03	PANEL, meter

UPRIGHT STATION METERING & INTERCOM

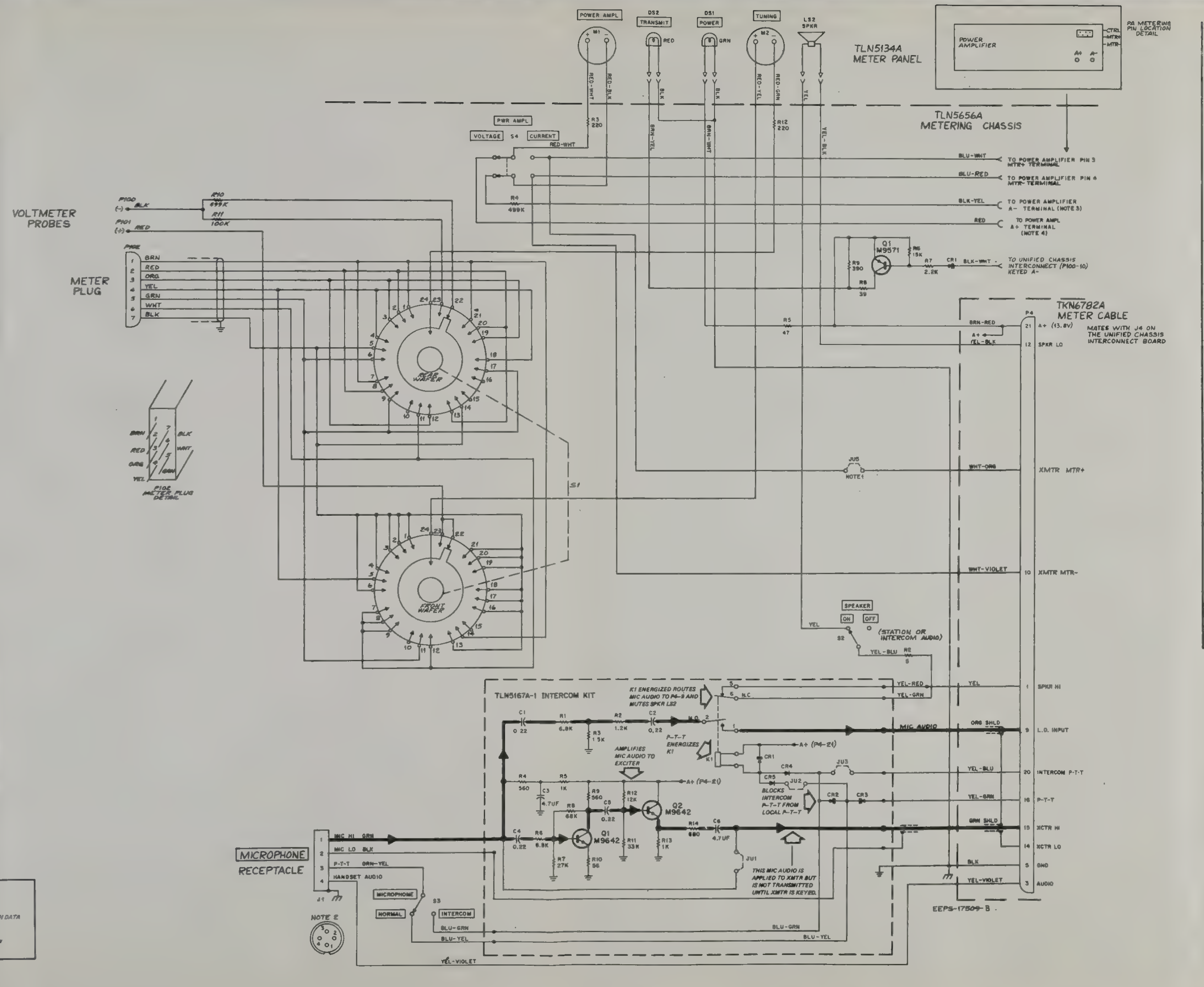
MODELS TLN1739A AND TLN5134A

FUNCTION

Provides built-in metering of over 20 major test points in the transmitter and receiver(s). Plus intercom between the station and the remote control point.



Motorola No. PEPS-17760-E
(Sheet 3 of 3)
9/1/80-UP



OPERATING INSTRUCTIONS

1. METERING

Step 1. Tuning Meter Usage -- Select the function to be metered with the meter switch. Next, select the chassis to be monitored by placing the metering plug (P102) into the metering receptacle of the receiver, exciter, power control board, or the power amplifier. NOTE: Metering plug P102 should be plugged in only when tuning. Unplug it when it is not being used. For receiver discriminator adjustment, use both 4(+) and 4(—) and adjust for meter zero.

Step 2. PWR AMP Meter Usage -- Select PA current/voltage monitoring by placing the VOLTAGE/CURRENT switch in the applicable position.

Step 3. Refer to the Transmitter and Receiver sections of this manual for typical or minimum readings. Better yet, keep a log of all meter readings each time the station is serviced. Use the last set of readings as a reference and note any degradation in performance.

Step 4. Voltmeter Usage -- Use either the 5 V or 25 V scales as applicable. Divide the 5 V full scale reading by 10 to obtain actual voltage. Divide the 25 V full scale reading by 2 to obtain actual voltage.

2. INTERCOM

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER switch in the ON position.

Step 3. Place the NORMAL-INTERCOM switch in the INTERCOM position.

Step 4. The unit is now ready for intercom operation between the station and the remote control point. Close the PUSH-TO-TALK switch on the microphone and speak into the microphone to send a message. Release the button to listen; replies will be heard in the speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

Step 5. Return the SPEAKER switch to the OFF position before leaving the station unattended.

3. "ON-THE-AIR" TESTING

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER switch in the ON position.

Step 3. Place the NORMAL-INTERCOM in the NORMAL position.

Step 4. The unit is now ready for "on-the-air" testing. If the micrphone PUSH-TO-TALK switch is closed, the station's transmitter will be keyed. Speak into the microphone to transmit a message. Release the PUSH-TO-TALK switch to listen. Receiver audio will be heard on the speaker.

Step 5. Return the SPEAKER switch to OFF before leaving the station unattended.

4. MONITORING

To monitor audio quality, etc., place the SPEAKER switch in the ON position. Both receiver audio and line audio from the remote control point will be heard in the speaker.

MODEL COMPLEMENT TABLE

MODEL	CONSISTS OF
TLN1739A METERING CHASSIS	TLN5656A METERING CHASSIS TLN5167A INTERCOM BOARD KIT TKN6782A CABLE KIT
TLN5134A METER PANEL	--

NOTES.

1. JU6 - IN FOR 12 W MODELS, OUT FOR ALL OTHER MODELS
2. INTERCOM REQUIRES THE USE OF A MOTOROLA MODEL TMN6071A MICROPHONE, OR EQUIVALENT.
3. ON 12-WATT STATIONS, BLK-YEL A(—) LEAD IS CONNECTED TO TB2-2 (—) ON UNIFIED CHASSIS INTERCONNECT BOARD.
4. ON 12-WATT STATIONS, RED A(+) LEAD IS CONNECTED TO TB2-1 (+) ON UNIFIED CHASSIS INTERCONNECT BOARD.

METER SELECT TABLE

P102 METERING PLUG CONNECTED TO	METER SELECTOR SW MTR NO.		POSITION	FUNCTION METERED	
RCVR RF & IF BOARD	RECEIVER	1	1	CHANNEL ELEMENT OUTPUT (3RD HARMONIC	
		2	2	1ST DOUBLER OUTPUT	
		3	3	2ND DOUBLER OUTPUT	
		4 (+)	4	DISCRIMINATOR OUTPUT	
		4 (−)	5	DISCRIMINATOR OUTPUT	
		5	6	LIMITER OUTPUT	
POWER AMPLIFIER	PA	1	7	PREDRIVER CURRENT	
		2	8	25 W DRIVER CURRENT (75 W MODEL ONLY)	
		5	9	CONTROLLED (ADL) STAGE VOLTAGE	
		–	10		
POWER CONTROL BOARD	PWR CONT	5	11	FINAL AMPLIFIER CURRENT (12 W STATIONS [illegible]	
		3	12	ADL VOLTAGE	
		2	13	REFLECTED POWER	
		1	14	FORWARD POWER	
--	--	–	15	UNUSED	
EXCITER	XCTR	6	16	UNUSED	
		5	17	EXCITER OUTPUT	
		4	18	DOUBLER INPUT	
		3	19	TRIPLER INPUT	
		2	20	CHANNEL ELEMENT OUTPUT	
		1	21	"IDC" AUDIO OUTPUT	
--	--	–	22	25 VOLTS FULL SCALE	METER IS LABELED 0–50
--	--	–	23	5 VOLTS FULL SCALE	
--	--	–	24	OFF	

PARTS LIST

TLN5656A Metering Kit PL-3416-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR1	48-82392B03	DIODE: (SEE NOTE) silicon
J1	9-830418	CONNECTOR, receptacle: 4-contact
Q1	48-869571	TRANSISTOR: (SEE NOTE) PNP; type M9571
		CONNECTOR, plug
P100	29-82676C01	test probe: BLACK
P101	29-82676C02	test probe: RED
P102	28-84208B01	7-contact
		RESISTOR, fixed ±10%, 1/2 W unless otherwise stated
R1		NOT USED
R2	[illegible]	[illegible], 5 W
R3	6-124A33	220
R4, 10	6-84640C61	499k ±1%
[illegible]	[illegible]	47
[illegible]	[illegible] 124A77	15k ±5% 1/4 W
[illegible]	[illegible]-124A57	2.2k ±5% 1/4 W
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
R11	6-12736D88	100k ±1%
R12	6-125A33	220 ±5%
		SWITCH:
S1	40-83158C01	rotary 2 section
S2, 3	40-83890A01	slide; dpdt
S4	40-811751	toggle; dpdt
NON-REFERENCED ITEMS		
	42-890493	CLAMP, cable 1/2
	[illegible]	KNOB, control
	31-490181	TERMINAL STRIP, 1-lug; 2 req'd.
	42-871184	CLIP, probe; 3 req'd.
	30-83678K01	CABLE, 7-conductor; 57" long (used with P102)
	15-83947K01	COVER; 2 req'd. (used with P102)
	42-83948K01	CLAMP, cable; 2 req'd.
	31-835961	TERMINAL BOARD, 18-lug
	27-83400K01	CHASSIS

NOTE
For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

TKN6782A Cable Kit PL-3417-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
P4		CONNECTOR includes
	9-84151B03	CONTACT, receptacle: 12 req'd.
	14-84556B02	HOUSING

TLN5134A Meter Panel PL-[illegible]

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		LIGHT, indicator
DS1	65-83183G02	includes lamp and GRN lens
DS2	65-83183G04	includes lamp and RED lens
		SPEAKER, permanent magnet
LS1	[illegible]	[illegible]
		METER, electrical: 50 uA movements:
M1	[illegible]	[illegible]
M2	[illegible]	[illegible]
NON-REFERENCED ITEMS		
	[illegible]	GRILLE, speaker
	15-83207F01	CLOTH, speaker grille
	42-83112A01	CLIP, indicator light retaining; 2 used
	[illegible]	NUT, hex [illegible] 4 used
	3-119916	SCREW, machine: 10-32 x 7/16 4 used
	3-131964	SCREW, tapping: 6-32 x 3 [illegible] 12 used
	[illegible]	WASHER [illegible] 4 used
	[illegible]	FRAME, top
	[illegible]	FRAME, bottom
	[illegible]	FRAME, end 2 used
	13-83054C10	GRILLE, meter [illegible]
	64-83152C03	PANEL, meter

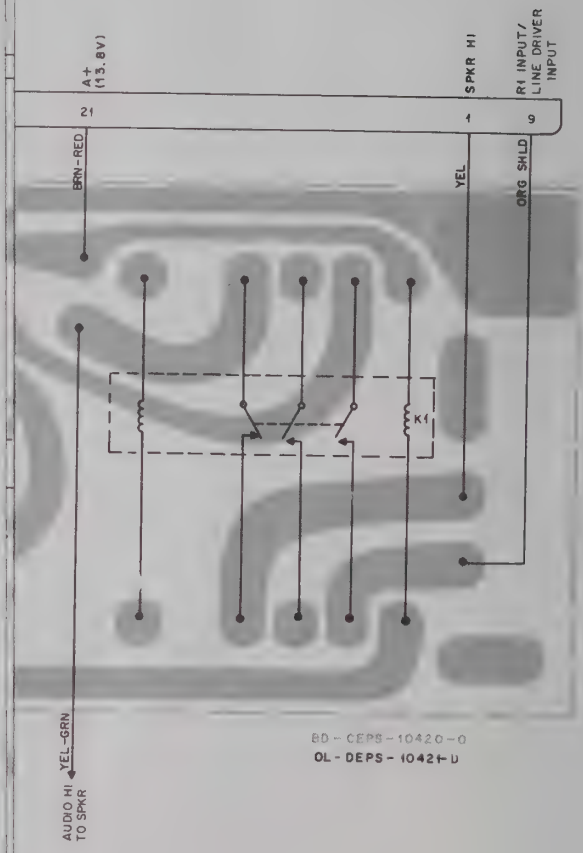
METERING & INTERCOM

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN5167A Intercom Board PL-5076-O

		CAPACITOR, fixed: uF:
C1, 2	8-82905G11	0.22 ±10%; 50 V
C3	23-865137	4.7 ±20%; 25 V
C4, 5	8-82905G11	0.22 ±10%; 50 V
C6	23-865137	4.7 ±20%; 25 V
		SEMICONDUCTOR DEVICE, diode:
CR1 thru 5	48-83654H01	silicon
		SWITCH, magnetic reed: 13.4 V DC:
K1	80-84157B02	dual-coil; 2 form "A", 1 form "B"; resistance of each coil 285 ohms ±10%
		TRANSISTOR:
Q1, 2	48-869642	NPN; type M9642
		RESISTOR, fixed: ±10%; 1/4 W:
R1	6-124C69	6.8k
R2	6-124C51	1.2k
R3	6-124C53	1.5k
R4	6-124C43	560
R5	6-124C49	1k
R6	6-124C69	6.8k
R7	6-124C83	27k
R8	6-124C93	68k
R9	6-124C43	560
R10	6-124C19	56
R11	6-124C85	33k
R12	6-124C75	12k
R13	6-124C49	1k
R14	6-124C45	680



REFEREN
SYMBO

PARTS
TLN590
TLN599

This par
appear t
in the de

C100

CR100,

J1

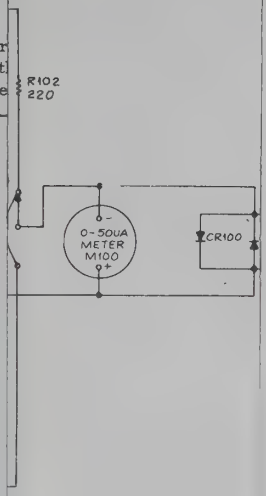
LS1

M100

P100
P101
P102

R100
R101
R102
R103
R104

S1
S2, 3



of readings as a
performance.

station voltages,
101) on either the 5
ull scale reading by
the 25 V full scale

to the microphone
assis.

F switch in the

RCOM switch in

ntercom operation
ntrol point. Close
microphone and

"COMPA-STATION" METERING & INTERCOM

MODELS TLN1857A AND TLN1886A INTERCOM

MODEL TLN1745A

FUNCTION

--Models TLN1857A and TLN1886A provide built-in metering of over 20 major test points in the transmitter and receiver(s), plus intercom between the station and the remote control point.

--Model TLN1745A provides intercom between the station and the remote control point.

METER SELECT TABLE

LOW BAND–MID BAND TLN1886A/TLN1887A		HIGH BAND TLN1857/TLN1859A		820 MHz/UHF TLN1857A/TLN1859A	
POL.	FUNCTION METERED	POL.	FUNCTION METERED	POL.	FUNCTION METERED
REV	EXTENDER CHANNEL ELEMENT	REV	–	FWD	CHANNEL ELEMENT OUTPUT
REV	–	REV	–	FWD	FIRST DOUBLER OUTPUT
REV	CHANNEL ELEMENT OUTPUT	REV	CHANNEL ELEMENT OUTPUT	FWD	SECOND DOUBLER OUTPUT
REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTPUT
REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTPUT
REV	THIRD IF OUTPUT AND LIMITER OUTPUT	REV	THIRD IF OUTPUT AND LIMITER OUTPUT	FWD	LIMITER OUTPUT
FWD	P.A. INPUT	REV	PA INPUT	FWD	PREDRIVER CURRENT
FWD		REV	CONTROLLED AMP OUTPUT	FWD	25 W DRIVER CURRENT (75 W)
FWD		REV	INPUT FINAL AMP 90/100 W/60 W PREDRIVER	FWD	FINAL AMP CURRENT (EXCEPT 12 W MODELS)
FWD	CONTROL VOLTAGE	REV	INPUT FINAL AMP.	FWD	–
FWD	FINAL AMPLIFIER CURRENT	REV	FINAL AMPLIFIER CURRENT	FWD	CONTROLLED (ADL) STAGE VOLTAGE FINAL AMPLIFIER CURRENT (12 W ONLY)
FWD	CONTROL VOLTAGE	FWD	CONTROL VOLTAGE	FWD	ADL VOLTAGE (ALL OTHERS)
FWD	–		–	FWD	ADL VOLTAGE NOT USED (800 MHz ONLY)
FWD	REFLECTED POWER	FWD	REFLECTED POWER	FWD	REFLECTED POWER
FWD	FORWARD POWER	FWD	FORWARD POWER	FWD	FORWARD POWER
	UNUSED		UNUSED		UNUSED
FWD	SECOND AMPLIFIER – (LB) DRIVER INPUT (MB)	FWD	EXCITER OUTPUT	FWD	EXCITER OUTPUT
FWD	FIRST AMPLIFIER (LB) DOUBLER INPUT – (MB)	FWD	FIRST DOUBLER INPUT	FWD	DOUBLER INPUT
FWD	TRIPLER INPUT	FWD	TRIPLER INPUT	FWD	TRIPLER INPUT
FWD	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTPUT
FWD	IDC AUDIO OUTPUT	FWD	IDC AUDIO OUTPUT	FWD	IDC AUDIO OUTPUT
FWD	25 VOLTS FULL SCALE	FWD	25 VOLTS FULL SCALE	FWD	25 VOLTS FULL SCALE
FWD	5 VOLTS FULL SCALE NOTE: METER IS LABELLED 0–50	FWD	5 VOLTS FULL SCALE NOTE: METER IS LABELLED 0–50	FWD	5 VOLTS FULL SCALE NOTE METER IS LABELLED 0–50
	OFF		OFF		OFF

EPS -23014–A

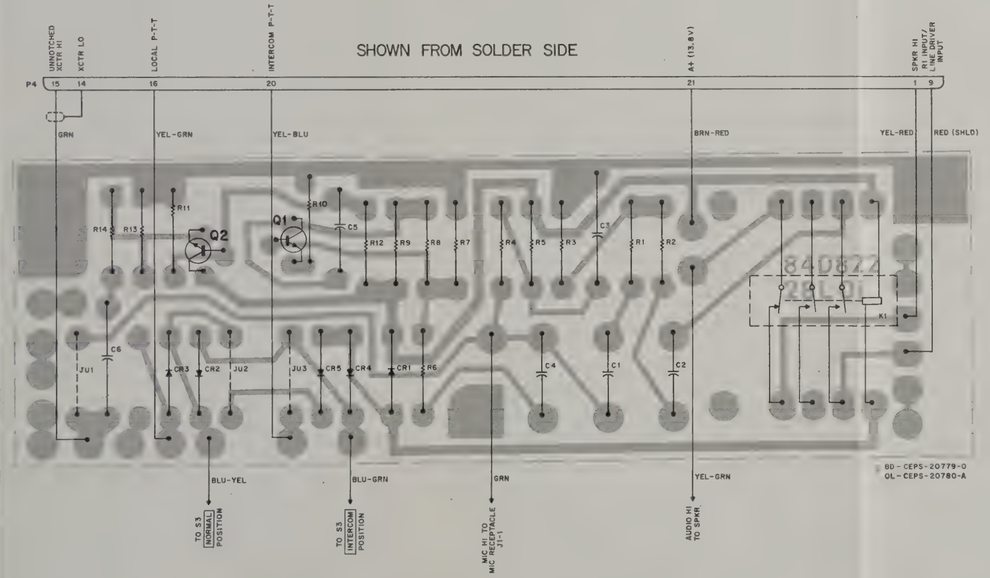
REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

PARTS LIST

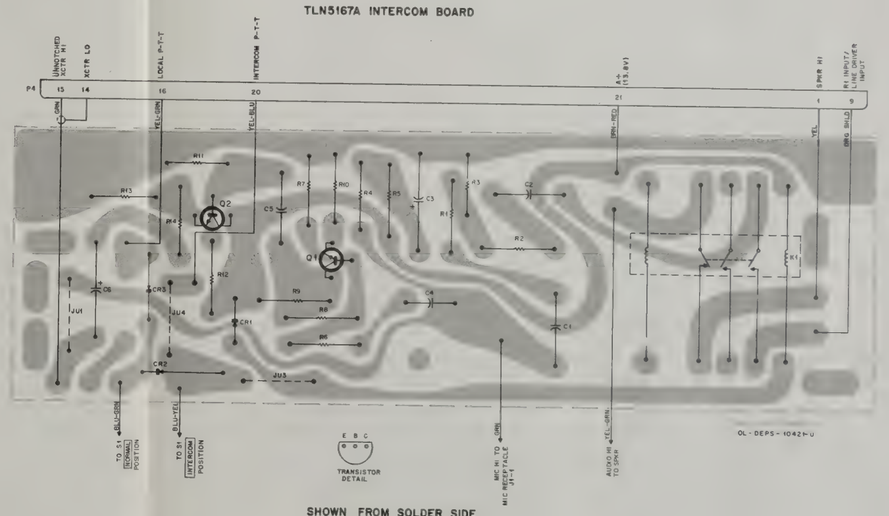
TLN5167A Intercom Board — PL-5076-O

		CAPACITOR, fixed: uF:
C1, 2	8-82905G11	0.22 ±10%; 50 V
C3	23-865137	4.7 ±20%; 25 V
C4, 5	8-82905G11	0.22 ±10%; 50 V
C6	23-865137	4.7 ±20%; 25 V
		SEMICONDUCTOR DEVICE, diode:
CR1 thru 5	48-83654H01	silicon
		SWITCH, magnetic reed: 13.4 V DC:
K1	80-84157B02	dual-coil; 2 form "A", 1 form "B"; resistance of each coil 285 ohms ±10%
		TRANSISTOR:
Q1, 2	48-869642	NPN; type M9642
		RESISTOR, fixed: ±10%; 1/4 W:
R1	6-124C69	6.8k
R2	6-124C51	1.2k
R3	6-124C53	1.5k
R4	6-124C43	560
R5	6-124C49	1k
R6	6-124C69	6.8k
R7	6-124C83	27k
R8	6-124C93	68k
R9	6-124C43	560
R10	6-124C19	5k
R11	6-124C85	33k
R12	6-124C75	12k
R13	6-124C49	1k
R14	6-124C45	680

CURRENT VERSION



EARLIER VERSION



PARTS LIST

TLN5900A Meter Kit
TLN5993A Meter Kit

NOTE

This parts list covers two meter kits. Where differences appear the model number of the applicable kit is indicated in the description column.

PL-5077-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C100	21-82428B24	.01 uF +80-20%: 500 V
		DIODE: (SEE NOTE)
CR100, 101	48-82420C03	silicon
		CONNECTOR, receptacle:
J1	9-830418	4-contact
		LOUDSPEAKER; permanent:
LS1	50-84710G01	dynamic type; 3"; square 16 ohms voice coil impedance
		METER, dc:
M100	72-83120C02	scale; 0-50 microamperes
		CONNECTOR, plug:
P100	29-82676C01	test probe; BLACK
P101	29-82676C02	test probe: RED
P102	28-84208B01	7-contacts
		RESISTOR, fixed:
R100	6-84640C61	499k ±0.5%: 1/4 W
R101	6-13756D88	100k ±1%: 1/2 W
R102	6-124A33	220 ohm ±5%: 1/4 W
R103	17-82177B55	8 ±10%: 7 W
R104	17-82177B44	13 ±10%: 15 W
		SWITCH:
S1	40-83158C01	rotary; 2 section
S2, 3	40-83890A01	slide; dpdt
NON-REFERENCED ITEMS		
	1-80775R56	DIODE & CAPACITOR ASSEMBLY includes: DIODES CR100 & CR101 CAPACITOR C100
	1-80775B58	CABLE ASSEMBLY includes;
	3-129674	SCREW, machine; 4-40 x 3/16"; 2 used
	3-132341	SCREW, machine: 4-36 x 1/4"; 2 used
	15-83947K01	COVER, connector; 2 used
	30-83678K01	CABLE, 7-conductor; 42" lg.
	42-83948K01	CLAMP, cable; 2 used
	1-80775B61	VOLTMETER PROBES includes: CONNECTORS P100 & P101
	1-80792B23	SWITCH ASSEMBLY, wired (TLN5900A) includes: SWITCH S1
	1-80795B11	SWITCH ASSEMBLY, wired (TLN5993A) includes: SWITCH S1
	1-80792B24	CHASSIS ASSEMBLY includes:
	4-7555	WASHER, flat: .128 x .250 x .033"; 2 used
	27-83008K03	CHASSIS, metering
	31-490181	TERMINAL STRIP: 2-terminal; 2 used
	31-823389	TERMINAL STRIP; 2 used
	42-871184	CLIP, mounting; 2 used SWITCHES S2, S3, & S4
	1-80793B04	COVER ASSEMBLY includes:
	1-80793B05	COVER SUBASSEMBLY includes:
	15-82734L01	COVER
	3-136138	SCREW, tapping: 6-32 x 3/8"; 2 used
	42-83123F01	RETAINER, screws; 2 used
	75-838826	BUMPER, rubber; 4 used
	2-7005	NUT, hex: 6-32 x 1/4 x 3/32"
	2-7018	NUT, hex: 3/8-32 x 1/2 x 3/32"
	2-132616	NUT, hex: 6-32 x 1/4 x 3/32"; 4 used
	2-83896G01	NUT, special: 13/16-27 x .905 x .110"

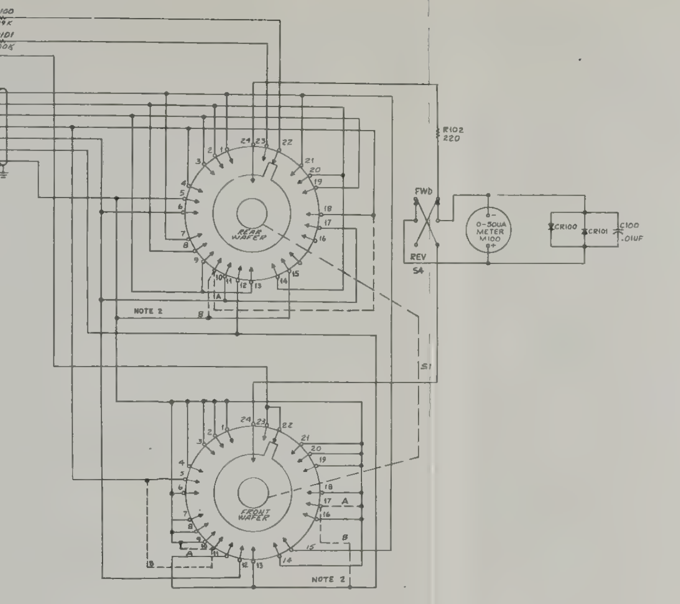
REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
	3-7331	SCREW, machine: 6-32 x 3/8
	3-129498	SCREW, machine: 6-32 x 5/16; 4 used
	3-134169	SCREW, tapping: 4-40 x 1/4; 6 used
	3-135111	SCREW, tapping: 4-40 x 3/8
	4-7568	WASHER, flat: .378 x .562 x .067"
	4-7650	WASHER, lock: #6 (internal tooth)
	4-7698	WASHER, lock: #3/8 (internal tooth)
	4-7699	WASHER, lock: #13/16 (internal tooth)
	4-114057	WASHER, flat: .125 x .312 x .032"
	4-858060	WASHER, insulating: .125 x 7/32 x .060"; 3 used
	5-483208	GROMMET, rubber: 1/2" ID
	7-83198K01	BRACKET, meter
	14-84717F01	INSULATOR: .68 x .40"
	29-5247	LUG, soldering: #1/4 L; 2 used
	29-115147	LUG, soldering: #5
	35-84530G01	GRILLE, speaker
	36-84356C01	KNOB, pointer
	42-859067	CLAMP, cable: 1/2" OD (black)
	42-10217A02	STRAP, cable harness; 4 used
	42-82143C02	CLAMP, cable: 1/4" OD (black)
	54-83147L01	LABEL, caution

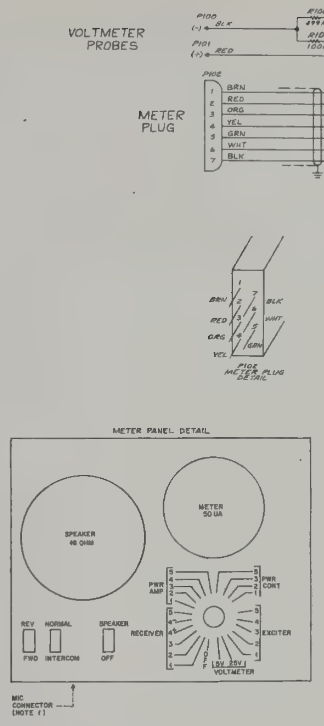
TKN6780A Cable Kit PL-3418-A

		CONNECTOR:
P4	-	includes:
	9-84151B03	CONTACT, receptacle; 10 req'd
	14-84556B02	HOUSING
NON-REFERENCED ITEM		
	42-10217A02	STRAP, cable harness; 7 used

TRN6189A Intercom Chassis Kit PL-3452-A

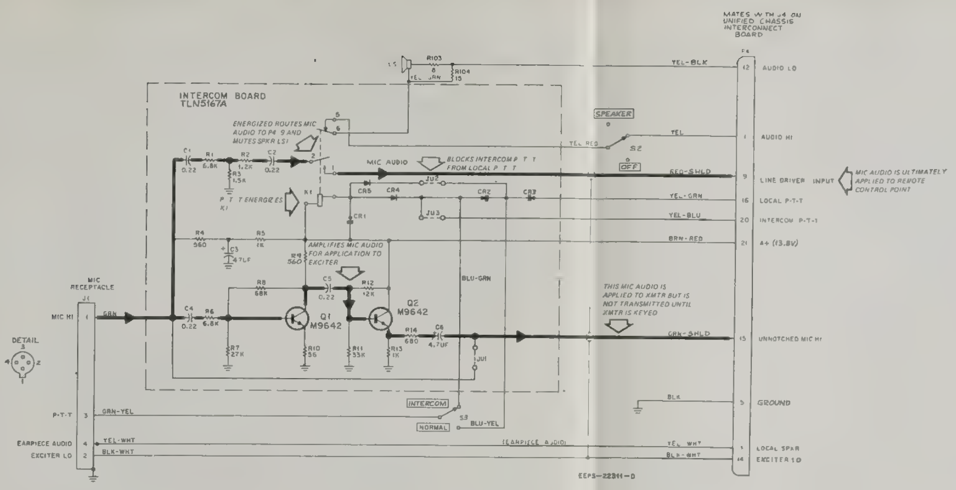
		CONNECTOR, receptacle:
J1	9-830418	4-contact
		SPEAKER
LS1	50-84710G01	3 ; 16 ohm
		RESISTOR, fixed; ±10%:
R103	17-82177B55	8; 7 W
R104	17-82177B44	13; 15 W
		SWITCH, slide:
S2, 3	40-11589	spst
NON-REFERENCED ITEMS		
	1-80775B59	CHASSIS (riveted) incl. ref. item S2 and S3
	1-80775B51	COVER ASSEMBLY
	2-132616	LOCKNUT, speaker (No. 6-32) 4 req'd.
	2-83896G01	NUT, hex (used with J1)
	4-7699	LOCKWASHER (used with J1)
	5-483208	GROMMET, rubber
	35-84530G01	GRILLE, speaker
	42-82143C02	CLAMP, cable (1/4")
	42-10217A02	TY-WRAP, cable: 4 req'd.
	3-134169	SCREW, machine: No. 4-40 x 1/4"; 7 req'd.
	3-129498	SCREW, machine: No. 6-32 x 5/16"; 4 req'd.
	29-115147	LUG, solder (No. 5)
	31-823389	TERMINAL, strip; 2 used





MODEL COMPLEMENT TABLE

MODEL	CONSISTS OF	
TLN1857A METERING & INTERCOM KIT	TLN5901A	METER KIT (CHASSIS)
	TLN5167A-1	INTERCOM BOARD KIT
	TKN6780A	CABLE KIT
TLN1886A METERING INTERCOM KIT	TLN5993A	METER KIT (CHASSIS)
	TLN5167A-1	INTERCOM BOARD KIT
	TKN6780A	CABLE KIT
TLN1745A INTERCOM KIT	TRN6189A	INTERCOM KIT (CHASSIS)
	TLN5167A-1	INTERCOM BOARD KIT
	TKN6780A	CABLE KIT



NOTE

[illegible] 12 W STATIONS, FINAL PA CURRENT IS METERED AT PWR CONT MTR 5. WITH ALL OTHER STATIONS, FINAL PA CURRENT IS METERED AT PA MTR 3.

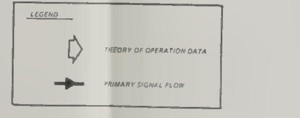
NOTE

1. THIS OPTION REQUIRES THE USE OF A MOTOROLA MODEL TMN6071A MICROPHONE, OR EQUIVALENT.

JUMPER TABLE

JUMPER	NORMAL	WHEN "SPECTRA TAC" IS ADDED (CUT CR2)
JU1	OUT	OUT
JU2	OUT	IN
JU3	OUT	IN

2. LEADS A CONNECTED FOR TLN5900A. LEADS B CONNECTED FOR TLN5993A.



OPERATING INSTRUCTIONS

1. METERING

Step 1. Select the function to be metered with the METER switch.

Step 2. Select the chassis to be monitored by placing the metering plug (P102) into the metering receptacle of the receiver, exciter, power control board or the power amplifier.

NOTE

Metering plug P102 should be plugged in only when tuning. Unplug it when it is not being used.

Step 3. For receiver discriminator adjustment, use both 4(+) and 4(-) and adjust for meter zero.

Step 4. Refer to the Transmitter and Receiver sections of this manual for typical or minimum readings. Better yet, keep a log of all meter readings each time the station is serviced. Use the last set of readings as a reference and note any degradation in performance.

Step 5. To measure miscellaneous station voltages, use the voltmeter probes (P100 and P101) on either the 5 V or 25 V positions. Divide the 5 V full scale reading by 10 to obtain actual voltage and divide the 25 V full scale reading by 2 to obtain actual voltage.

2. INTERCOM

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the INTERCOM position.

Step 4. The unit is now ready for intercom operation between the station and the remote control point. Close the PUSH-TO-TALK switch on the microphone and speaker into the microphone to send a message. Release the button to listen; replies will be heard in the speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

Step 5. Return the SPEAKER-OFF switch to the OFF position before leaving the station unattended.

3. "ON-THE-AIR" TESTING

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the NORMAL position.

Step 4. The unit is now ready for "ON-THE-AIR" testing. If the microphone PUSH-TO-TALK switch is closed, the station's transmitter will be keyed. Speak into the microphone to transmit a message. Release the PUSH-TO-TALK switch to listen. Receiver audio will be heard on the speaker.

Step 5. Return the SPEAKER-OFF switch to OFF before leaving the station unattended.

4. MONITORING

To monitor audio quality, etc., place the SPEAKER-OFF switch in the SPEAKER position. Both receiver audio and line audio from the remote control point will be heard in the speaker.

"COMPA-STATION" METERING & INTERCOM

MODELS TLN1857A AND TLN1886A

INTERCOM

MODEL TLN1745A

FUNCTION

--Models TLN1857A and TLN1886A provide built-in metering of over 20 major test points in the transmitter and receiver(s), plus intercom between the station and the remote control point.

--Model TLN1745A provides intercom between the station and the remote control point.

METER SELECT TABLE

P102 METER PLUG CONNECTED TO	METER SELECTOR SWITCH			LOW BAND-MID BAND TLN1886A/TLN1887A		HIGH BAND TLN1857/TLN1859A		820 MHz/UHF TLN1857A TLN1859A	
	MTR	NO	POS.	POL	FUNCTION METERED	POL	FUNCTION METERED	POL	FUNCTION METERED
RCVR AND IF BOARD	RCVR	1	1	REV	EXTENDER CHANNEL ELEMENT	REV	-	FWD	CHANN[illegible]
		2	2	REV		REV	-	FWD	FIRST [illegible]
		3	3	REV	CHANNEL ELEMENT OUTPUT	REV	CHANNEL ELEMENT OUTPUT	FWD	SECOND DOUBLER OUTP[illegible]
		4+	4	REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTP[illegible]
		4-	5	REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTPUT
		5	6	REV	THIRD IF OUTPUT AND LIMITER OUTPUT	REV	THIRD IF OUTPUT AND LIMITER OUTPUT	FWD	LIMITER OUTPUT
POWER AMP	PWR AMP	1	7	FWD	P A INPUT	REV	PA INPUT	FWD	PREDRIVER CURRENT
		2	8	FWD		REV	CONTROLLED AMP [illegible]	FWD	25 W DRIVER CUR[illegible]
		3	9	FWD		REV	INPUT FINAL AMP 90 100 W 60 W PREDRIVER	FWD	FINA[illegible] 12 W [illegible]
		4	10	FWD	CONTROL VOLTAGE	REV	INPUT FINAL AMP	FWD	
		5	11	FWD	FINAL AMPLIFIER CURRENT	REV	FINAL AMPLIFIER CURRENT	FWD	CONT[illegible]
POWER CONTROL BOARD	POWER CONT	5	12	FWD	CONTROL VOLTAGE	FWD	CONTROL VOLTAGE	FWD	ADL VOLTAGE (ALL OTHERS)
		3	13	FWD			-	FWD	ADL VOLTAGE NOT USED (800 MHz ON[illegible]
		2	14	FWD	REFLECTED POWER	FWD	REFLECTED POWER	FWD	RE[illegible]
		1	15	FWD	FORWARD POWER	FWD	FORWARD POWER	FWD	FORWARD POWER
			16		UNUSED		UNUSED		UNUSED
EXCITER	EXCTR	5	17	FWD	SECOND AMPLIFIER (LB) DRIVER INPUT (MB)	FWD	EXCITER OUTPUT	FWD	EXCITER OUTPUT
		4	18	FWD	FIRST AMPLIFIER (LB) DOUBLER INPUT - (MB)	FWD	FIRST DOUBLER INPUT	FWD	DOUB[illegible]
		3	19	FWD	TRIPLER INPUT	FWD	TRIPLER INPUT	FWD	TRIPLER INPUT
		2	20	FWD	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTP[illegible]
		1	21	FWD	IDC AUDIO OUTPUT	FWD	IDC AUDIO OUTPUT	FWD	IDC AUDIO OUTPUT
	VOLT METER	25 V	22	FWD	25 VOLTS FULL SCALE	FWD	25 VOLTS FULL SCALE	FWD	25 VOLTS FULL SCALE
		5 V	23	FWD	5 VOLTS FULL SCALE NOTE METERS LABELLED 0-50	FWD	5 VOLTS FULL SCALE NOTE METERS LABELLED 0-50	FWD	5 VOLTS [illegible]
	OFF	-	24		OFF		OFF		OFF

EPS-23014-A

PARTS LIST

TLN5901A Meter Kit
TLN5994A Meter Kit

NOTE

This parts list covers two meter kits. Where differences appear the model number of the applicable kit is indicated in the description column.

PL-5078-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		DIODE: (SEE NOTE)
CR1	48-82392B03	silicon
		CONNECTOR, receptacle:
J1	9-830418	4-contact
		TRANSISTOR: (SEE NOTE)
Q1	48-869571	PNP; type M9571
		CONNECTOR, plug:
P100	29-82676C01	test probe; BLACK
P101	29-82676C02	test probe; RED
P102	28-84208B01	7-contact
		RESISTOR, fixed: ±10%; 1/2 W: unless otherwise stated
R1		NOT USED
R2	17-82177B55	8; 7 W
R3	6-124A33	220
R4, 10	6-84640C61	499k ±1%
R5	6-125C17	47
R6	6-124A77	15k ±5%; 1/4 W
R7	6-124A57	2.2k ±5%; 1/4 W
R8	6-125C15	39
R9	6-125A39	390
R11	6-12756D88	100k ±1%
R12	6-125A33	220 ±5%
		SWITCH:
S1	40-83158C01	rotary; 2 section
S2, 3	40-83890A01	slide; dpdt
S4	40-811751	toggle; dpdt
S5	40-83890A01	slide; dpdt
NON-REFERENCED ITEMS		
	1-80775B55	CABLE ASSEMBLY includes:
	3-129674	SCREW, machine: 4-40 x 3/16"; 2 used
	3-132341	SCREW, machine: 4-36 x 1/4" 2 used
	15-83947K01	COVER, connector: 2 used
	30-83678K01	CLAMP, cable; 2 used
		CONNECTOR P102
	1-80775B60	VOLTMETER PROBES includes:
		CONNECTORS P100 & P101
	1-80792B39	SWITCH ASSEMBLY, wired (TLN5901A)
	1-80795B12	SWITCH ASSEMBLY, wired (TLN5994A) includes:
		SWITCH S1
	1-80793B03	CHASSIS ASSEMBLY includes:
	4-7555	WASHER, flat: .128 x .250 x .033"; 3 used
	27-83400K02	CHASSIS, metering
	29-115147	LUG, soldering: #5
	31-490101	TERMINAL STRIP: 2-terminal; 2 used
	42-871184	CLIP, mounting; 3 used
	2-7018	NUT, hex: 3/8-32 x 1/2 x 3/32
	2-115190	NUT, hex: 15/32-32 x 9/16 x 5/64"
	2-121841	NUT, hex: 6-32 x 5/16 x 7/64"
	2-83896G01	NUT, special: 13/16-27 x .905 x .110"
	3-134185	SCREW, tapping: 6-32 x 1/4: 2 used
	3-134212	SCREW, tapping: 4-40 x 5/16; 3 used
	3-136934	SCREW, tapping: 6-32 x 3/8"
	4-7698	WASHER, lock: #3/8 (internal tooth)
	4-7699	WASHER, lock: #13/16 (internal tooth)
	4-8324	WASHER, lock: #15/32 (split)
	14-84717F01	INSULATOR: .68 x .40"
	29-5279	LUG, soldering: #7/8
	31-835961	TERMINAL STRIP, 18-terminal
	36-82630H01	KNOB, control
	42-890499	CLAMP, cable: 3.18 x .62"
	42-10217A02	STRAP, cable harness

TKN6886A Cable Kit PL-5207-A

		CONNECTOR:
P4	-	includes:
	9-84151B03	CONTACT, receptacle: 12 used
	14-84556B02	HOUSING, connector
NON-REFERENCED ITEMS		
	14-859051	INSULATOR, lug: .315 x .945"; 6 used
	29-5247	LUG, soldering: #1/4 L; 4 used
	29-824456	LUG, ring tongue: 2 used
	29-859118	LUG, receptacle: .295 x .750"; 6 used
	37-82603D60	SLEEVE, numbered; blank
	39-10184A24	CONTACT, female
	42-10217A02	STRAP, cable harness; 3.62" lg.; 28 used
	42-10217A10	STRAP, cable harness; 7.78" lg.; 4 used
	9-84234E10	JACK, test; white; 3 used

TLN5134A Meter Panel PL-2233-A

		LIGHT, indicator:
DS1	65-83183G02	includes lamp and GRN lens
DS2	65-83183G04	includes lamp and RED lens
		LOUDSPEAKER, permanent magnet:
LS1	50-83562A01	dynamic type; 4"; square; 4 ohms voice coil impedance
		METER, electrical: 50 uA movements:
M1	72-84864B10	scale: 0-25 volts/amps
M2	72-84864B09	scale: 0-50 microamperes
NON-REFERENCED ITEMS		
	13-84616G01	GRILLE, speaker
	13-83207F01	CLOTH, speaker grille
	42-83112A01	CLIP, indicator light retaining; 2 used
	2-7009	NUT, hex: 10-32 x 3/8 x 1/8"; 4 used
	3-119916	SCREW, machine: 10-32 x 7/16" 4 used
	3-131964	SCREW, tapping: 6-32 x 3/8; 12 used
	4-7658	WASHER, lock: #10 (split); 4 used
	7-84620G01	FRAME, top
	7-84620G03	FRAME, bottom
	7-84620G05	FRAME, end: 2 used
	13-83054C10	GRILLE, meter panel
	64-83152C03	PANEL, meter

UPRIGHT STATION METERING & INTERCOM

MODELS TLN1859A AND TLN1887A

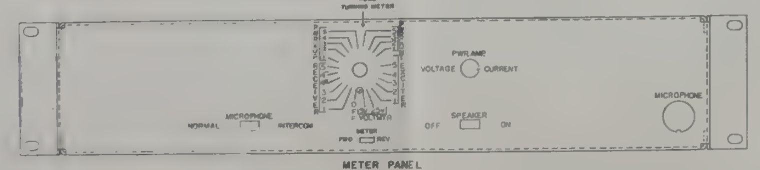
FUNCTION

Provides built-in metering of over 20 major test points in the transmitter and receiver(s). Plus intercom between the station and the remote control point.

METER SELECT TABLE

P102 METER PLUG CONNECTED TO	METER SELECTOR SWITCH MTR	NO.	POS.	LOW BAND - MID BAND TLN1886A/TLN1887A POL	FUNCTION METERED	HIGH BAND TLN1857/TLN1859A POL.	FUNCTION METERED	820 MHz/UHF TLN1857A/TLN1859A POL.	FUNCTION METERED
RCVR AND IF BOARD	RCVR	1	1	REV	EXTENDER CHANNEL ELEMENT	REV	–	FWD	CHANNEL ELEMENT OUTPUT
		2	2	REV	–	REV	–	FWD	FIRST DOUBLER OUTPUT
		3	3	REV	CHANNEL ELEMENT OUTPUT	REV	CHANNEL ELEMENT OUTPUT	FWD	SECOND DOUBLER OUTPUT
		4+	4	REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTPUT
		4–	5	REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTPUT
		5	6	REV	THIRD IF OUTPUT AND LIMITER OUTPUT	REV	THIRD IF OUTPUT AND LIMITER OUTPUT	FWD	LIMITER OUTPUT
POWER AMP	PWR AMP	1	7	FWD	P.A. INPUT	REV	PA INPUT	FWD	PREDRIVER CURRENT
		2	8	FWD	–	REV	CONTROLLED AMP OUTPUT	FWD	25 W DRIVER CURRENT (75 W)
		3	9	FWD	–	REV	INPUT FINAL AMP 90/100 W/60 W PREDRIVER	FWD	FINAL AMP CURRENT (EXCEPT 12 W MODELS)
		4	10	FWD	CONTROL VOLTAGE	REV	INPUT FINAL AMP	FWD	–
		5	11	FWD	FINAL AMPLIFIER CURRENT	REV	FINAL AMPLIFIER CURRENT	FWD	CONTROLLED (ADL) STAGE VOLTAGE FINAL AMPLIFIER CURRENT (12 W ONLY)
POWER CONTROL BOARD	POWER CONT.	5	12	FWD	CONTROL VOLTAGE	FWD	CONTROL VOLTAGE	FWD	ADL VOLTAGE (ALL OTHERS)
		3	13	FWD	–		–	FWD	ADL VOLTAGE NOT USED (800 MHz ONLY)
		2	14	FWD	REFLECTED POWER	FWD	REFLECTED POWER	FWD	REFLECTED POWER
		[illegible]	15	FWD	FORWARD POWER	FWD	FORWARD POWER	FWD	FORWARD POWER
–	–	–	16		UNUSED		UNUSED		UNUSED
EXCITER	EXCTR	5	17	FWD	SECOND AMPLIFIER – (LB) DRIVER INPUT – (MB)	FWD	EXCITER OUTPUT	FWD	EXCITER OUTPUT
		4	18	FWD	FIRST AMPLIFIER – (LB) DOUBLER INPUT – (MB)	FWD	FIRST DOUBLER INPUT	FWD	DOUBLER INPUT
		3	19	FWD	TRIPLER INPUT	FWD	TRIPLER INPUT	FWD	TRIPLER INPUT
		2	20	FWD	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTPUT
		1	21	FWD	IDC AUDIO OUTPUT	FWD	IDC AUDIO OUTPUT	FWD	IDC AUDIO OUTPUT
	VOLT-METER	25 V	22	FWD	25 VOLTS FULL SCALE	FWD	25 VOLTS FULL SCALE	FWD	25 VOLTS FULL SCALE
		5 V	23	FWD	5 VOLTS FULL SCALE NOTE METER IS LABELLED 0–50	FWD	5 VOLTS FULL SCALE NOTE METER IS LABELLED 0–50	FWD	5 VOLTS FULL SCALE NOTE METER IS LABELLED 0–50
	OFF	–	24		OFF		OFF		OFF

EPS-23014-A



METER PANEL DETAIL

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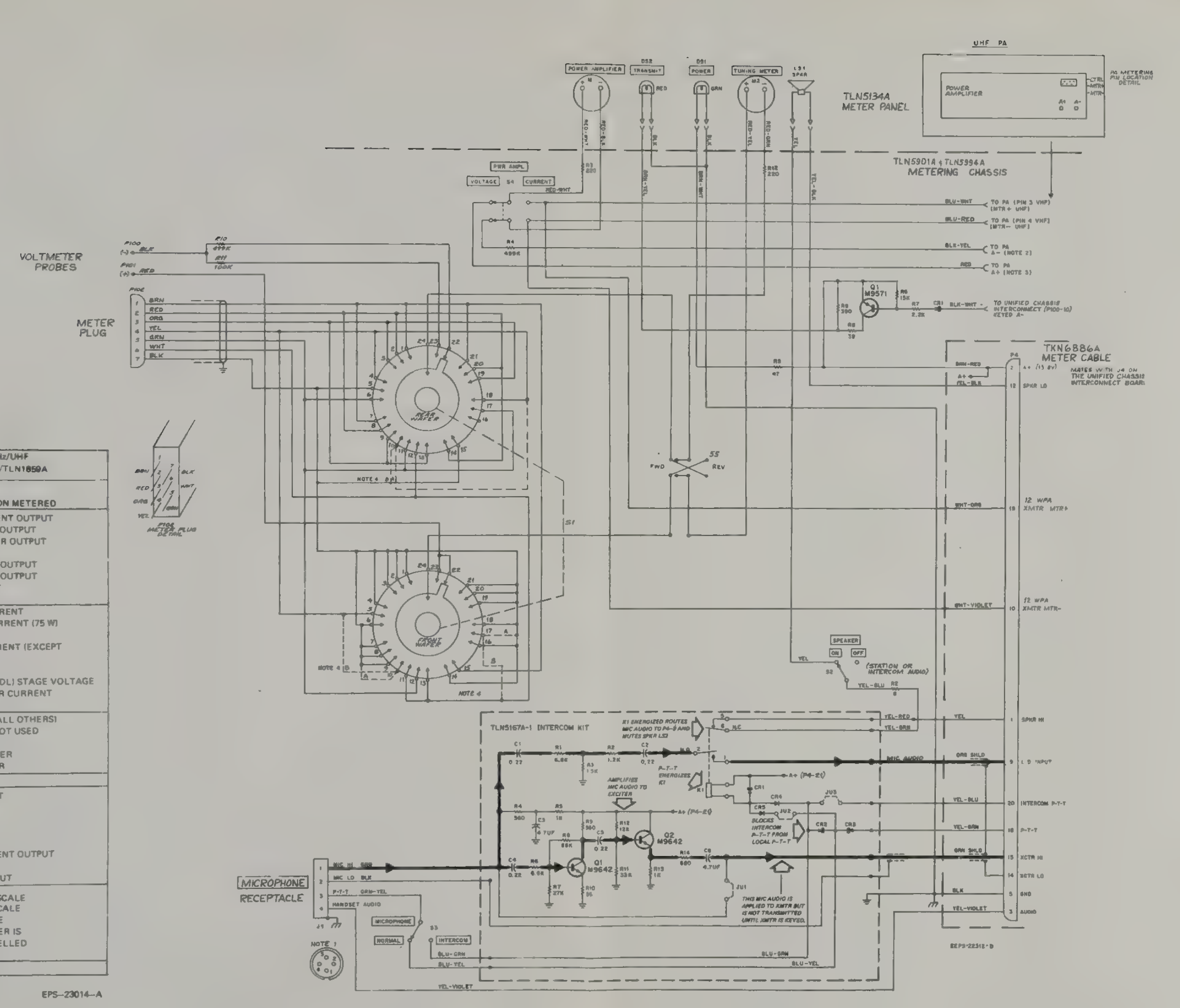
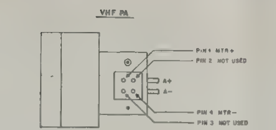
(Sheet 3 of 3)
9/1/80-UP





MODEL COMPLEMENT TABLE

MODEL	CONSISTS OF	
TLN1859A METERING & INTERCOM KIT	TLN5901A	METER KIT (CHASSIS)
	TLN5167A-1	INTERCOM BOARD KIT
	TKN6886A	CABLE KIT
TLN1887A METERING & INTERCOM KIT	TLN5994A	METER KIT (CHASSIS)
	TLN5167A-1	INTERCOM BOARD KIT
	TKN6886A	CABLE KIT

NOTES

1. INTERCOM REQUIRES THE USE OF A MOTOROLA MODEL TMN6071A MICROPHONE OR EQUIVALENT
2. ON 12-WATT UHF STATIONS, BLK-YEL A(–) LEAD IS CONNECTED TO TB2-2 ON UNIFIED CHASSIS INTERCONNECT BOARD.
3. ON 12-WATT UHF STATIONS, RED A(+) LEAD IS CONNECTED TO TB3-1 (+) ON UNIFIED CHASSIS INTERCONNECT BOARD.
4. LEADS A CONNECTED FOR TLN5901A. LEADS B CONNECTED FOR TLN5994A.

LEGEND
- THEORY OF OPERATION DATA
- PRIMARY SIGNAL FLOW

OPERATING INSTRUCTIONS

1. METERING

Step 1. Tuning Meter Usage -- Select the function to be metered with the meter switch. Next, select the chassis to be monitored by placing the metering plug (P102) into the metering receptacle of the receiver, exciter, power control board, or the power amplifier. NOTE: Metering plug P102 should be plugged in only when tuning. Unplug it when it is not being used. For receiver discriminator adjustment, use both 4(+) and 4(-) and adjust for meter zero.

Step 2. PWR AMP Meter Usage -- Select PA current/voltage monitoring by placing the VOLTAGE/CURRENT switch in the applicable position.

Step 3. Refer to the Transmitter and Receiver sections of this manual for typical or minimum readings. Better yet, keep a log of all meter readings each time the station is serviced. Use the last set of readings as a reference and note any degradation in performance.

Step 4. Voltmeter Usage -- Use either the 5 V or 25 V scales as applicable. Divide the 5 V full scale reading by 10 to obtain actual voltage. Divide the 25 V full scale reading by 2 to obtain actual voltage.

2. INTERCOM

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER switch in the ON position.

Step 3. Place the NORMAL-INTERCOM switch in the INTERCOM position.

Step 4. The unit is now ready for intercom operation between the station and the remote control point. Close the PUSH-TO-TALK switch on the microphone and speak into the microphone to send a message. Release the button to listen; replies will be heard in the speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

Step 5. Return the SPEAKER switch to the OFF position before leaving the station unattended.

3. "ON-THE-AIR" TESTING

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER switch in the ON position.

Step 3. Place the NORMAL-INTERCOM in the NORMAL position.

Step 4. The unit is now ready for "on-the-air" testing. If the microphone PUSH-TO-TALK switch is closed, the station's transmitter will be keyed. Speak into the microphone to transmit a message. Release the PUSH-TO-TALK switch to listen. Receiver audio will be heard on the speaker.

Step 5. Return the SPEAKER switch to OFF before leaving the station unattended.

4. MONITORING

To monitor audio quality, etc., place the SPEAKER switch in the ON position. Both receiver audio and line audio from the remote control point will be heard in the speaker.

PARTS LIST

TLN5901A Meter Kit
TLN5994A Meter Kit

NOTE
This parts list covers two meter kits. Where differences appear the model number of the applicable kit is indicated in the description column.

PL-5078-A

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
CR1	48-82392B03	DIODE: SEE NOTE silicon
J1	9-830418	CONNECTOR, receptacle: 4-contact
Q1	48-869571	TRANSISTOR: (SEE NOTE PNP; type M9571
		CONNECTOR, plug:
P100	29-82676C01	test probe; BLACK
P101	29-82676C02	test probe; RED
P102	28-84208B01	7-contact
		RESISTOR, fixed: ±10%; 1/2 W: unless otherwise stated
R1		NOT USED
R2	17-82177B55	8; 7 W
R3	6-124A33	220
R4, 10	6-84640C61	499k ±1%
R5	6-125C17	47
R6	6-124A[illegible]	[illegible]
R7	6-124A57	2.2k [illegible] W
R8	6-125C15	39
R9	6-125A39	390
R11	6-12756D88	100k ±1%
R12	6-125A33	220 ±5%
		SWITCH:
S1	40-83158C01	rotary; 2 section
S2, 3	40-83890A01	slide; dpdt
S4	40-811751	toggle; dpdt
S5	40-83890A01	slide; dpdt
		NON-REFERENCED ITEMS
	1-80775B55	CABLE ASSEMBLY includes
	3-129674	SCREW, machine: 4-40 x 3/16"; 2 used
	3-132341	SCREW, machine: 4-36 x 1/4 2 used
	15-83947K01	COVER, connector: 2 used
	30-83678K01	CLAMP, cable; 2 used
		CONNECTOR P102
	1-80775B60	VOLTMETER PROBES includes. CONNECTORS P100 & P101
	1-80792B39	SWITCH ASSEMBLY, wired (TLN5901A)
	1-80795B12	SWITCH ASSEMBLY, wired (TLN5994A) includes: SWITCH S1
	1-80793B03	CHASSIS ASSEMBLY includes:
	4-7555	WASHER, flat: .128 x .250 x .033"; 3 used
	27-83400K02	CHASSIS, metering
	29-115147	LUG, soldering: #5
	31-490101	TERMINAL STRIP: 2-terminal; 2 used
	42-871184	CLIP, mounting: 3 used
	2-7018	NUT, hex: 3/8-32 x 1/2 x 3/32
	2-115190	NUT, hex: 15/32-32 x 9/16 x 5/64"
	2-121841	NUT, hex: 6-32 x 5/16 x 7/64"
	2-83896G01	NUT, special: 13/16-27 x .905 x .110"
	3-134185	SCREW, tapping: 6-32 x 1/4 2 used
	3-134212	SCREW, tapping: 4-40 x 5/16; 3 used
	3-136934	SCREW, tapping: 6-32 x 3/8"
	4-7698	WASHER, lock: #3/8 (internal tooth)
	4-7699	WASHER, lock: #13/16 (internal tooth)

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
	[illegible]	WASHER, [illegible]
	14-84717F01	INSULATOR: .68 x [illegible]
	29-5279	LUG, soldering: #7/8
	31-835961	TERMINAL STRIP, [illegible] al
	36-82630H01	KNOB, control
	42-890499	CLAMP, cable: 3.18 x .62
	42-10217A02	STRAP, cable harness

TKN6886A Cable Kit

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
P4	-	CONNECTOR, includes:
	9-84151B03	CONTACT, recepta[illegible]
	14-84556B02	HOUSING, conn[illegible]
		NON-REFERENCED ITEMS
	14-859051	INSULAT[illegible] 6 used
	29-5247	LUG, soldering: #1/4 L; 4 [illegible]
	29-824456	LUG, ring tongue: 2 used
	[illegible]	[illegible]
	37-82603D[illegible]	[illegible]
	[illegible]	[illegible]
	42-10217A[illegible]	[illegible] ig., 4 used
	9-84234E10	JACK, test; w[illegible]

TLN5134A Meter Panel PL-2[illegible]

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
DS1	[illegible]	[illegible]
DS2	[illegible]	[illegible]
LS1	[illegible]	SPEAKER, [illegible]
M1	[illegible]	METER, [illegible]
M2	[illegible]	[illegible]
		NON-REFERENCED ITEMS
	13-84616G01	GRILLE, speaker
	13-83207F01	[illegible], speaker [illegible]
	42-83112A01	CLIP, indicator [illegible] 2 used
	2-7009	NUT, hex 10-32 [illegible] 4 used
	3-119916	SCREW, machine: 10-32 x 7[illegible] 4 used
	3-131964	SCREW, tapping: [illegible] 12 used
	4-7658	WASHER, lock: #10 (split 4 used
	7-84620G01	FRAME, top
	7-84620G03	FRAME, bottom
	7-84620G05	FRAME, end: 2 used
	13-83054C10	GRILLE, meter panel
	64-83152C03	PANEL, meter

EXCITER

MODEL TLF1192A

Model Complement

Model	Description
TLD5322B	Exciter
TFD6442A	VHF Helical Filter

Technical Characteristics

Frequency	Model TLD5322B: 154.6-160 MHz
Number of Channels	1 to 4
Maximum Frequency Separation	±750 kHz
Oscillator Frequency	12.8-13.3 MHz
Frequency Multiplication	12 times
Output Power	400 milliwatts
Output Impedance	50 ohms
Modulator Type	Direct FM
Deviation	±5 kHz, adjustable instantaneous deviation limiting
Audio Response	6 dB/octave pre-emphasis 300 to 3000 Hz
Audio Sensitivity	165 millivolts for ±3.0 kHz deviation
Audio Distortion	Less than 3% at ±3.0 kHz deviation from 300 to 3000 Hz
Power Requirements	Regulated +9.6 volts dc @150 mA +13.6 volts dc @100 mA
Construction Metering	Fully solid-state. Five test points critical to operation and alignment are accessible at a metering receptacle which permits testing with an optional built-in station meter, Motorola portable test set, or 0-50 uA microammeter with 2,000 ohms series resistance.

1. DESCRIPTION

1.1 The TLN5322B Exciter provides the low power excitation for an FM transmitter. Plug-in channel elements are used to develop a direct FM carrier signal of at least 400 milliwatts.

1.2 The exciter is directly frequency-modulated for crystal-controlled frequency operation in the 154.6-160 MHz range. It consists of a symmetrical clipper and splatter filter, emitter follower, channel element(s) (voltage controlled crystal oscillator), buffer amplifier, tripler, first doubler, second doubler, and output amplifier. The fundamental crystal frequency is multiplied by twelve to provide the final output frequency.

1.3 When the exciter is used in *Private-Line* squelch stations, a *Private-Line* squelch encoder circuit board is plugged directly into the mating pins of the exciter; and one jumper (JU402) is removed from the exciter; no interconnecting wires are used. The exciter board also includes additional pins that permit the board to be used with certain types of optional equipment. These pins are designated P403 on the exciter schematic diagram.

2. FUNCTIONAL OPERATION

Refer to Figure 1 and the Exciter schematic diagram included in this section.

2.1 DEVIATION LIMITING CIRCUIT

2.1.1 Microphone output audio is applied to the symmetrical clipper and splatter filter. This circuit, together with amplifier U401, provides pre-emphasis, amplification, and limiting of the microphone audio. Microphone audio is then applied to emitter follower Q401 (together with PL code) through the IDC (Instantaneous Deviation Control) potentiometer to the channel elements.

2.1.2 The output of the emitter follower is developed across IDC potentiometer R410. This audio signal can be monitored at pin 1 of the exciter metering receptacle. The potentiometer adjusts the maximum level of audio coupled to the oscillator-modulator, thus setting the amount of deviation.

2.1.3 In *Private-Line* squelch radios, a low amplitude *Private-Line* code is continuously injected into the oscillator-modulator from the *Private-Line* squelch encoder. This code range produces 0.5 to 1.0 kHz deviation.

2.2 MODULATOR-OSCILLATOR STAGE (CHANNEL ELEMENT)

2.2.1 The combination modulator-oscillator stage (channel element) produces a low-power crystal frequency signal modulator at an audio rate. This signal is multiplied twelve times and amplified in following stages to produce the carrier signal. The channel element consists of a parallel combination varactor and warping capacitor connected in series with a crystal. A change in capacitance seen at the crystal terminals causes the crystal to vary its resonant frequency in proportion to the capacitance change. The audio voltage from the audio and IDC circuitry is applied to the varactor to cause a change in capacitance; this variation in turn causes the frequency to change at the same audio rate.

2.2.2 Frequency generation is accomplished with either ovenized crystal controlled oscillator (channel elements) or a frequency synthesizer with ultra high stability for simulcast applications. A variable warp capacitor in the base of each channel element is accessible for fine frequency adjustment. Each channel element is a factory sealed, plug-in module which provides a train of stable frequency positive pulses.

2.2.3 The exciter accepts a signal from either the ovenized oscillator or frequency synthesizer. A power input of +9.6 volts is applied to the channel element continuously while the station is turned ON. Channel element output is developed only when a switched ground generated by the local or remote control unit is present. An indication of the channel element output is available at pin 2 of the metering socket. This allows channel element operation to be easily checked with optional built-in station metering or with a Motorola Portable test set.

NOTE

If the station is equipped with a time-out timer module and the time times out, keyed A– is removed from the modulator-oscillator(s) and the entire transmitter is shut down.

2.3 BUFFER AMPLIFIER

The buffer amplifier, Q404, is biased to operate as a Class A amplifier and provides reserve gain to isolate the modulator-oscillator from the succeeding stages.

2.4 MULTIPLIERS AND EXCITER POWER AMPLIFIER

2.4.1 The multipliers develop an output signal that is 12 times the channel element frequency and a final power amplifier gives power gain and matches the output impedance to 50 ohms.

2.4.2 The buffer amplifier output is developed across two parallel resonant tank circuits at the channel element frequency. Tripler Q405 operates as a Class C amplifier with its parallel resonant output tuned to the their harmonic of its input. Thus the output of the tripler is three times the channel element frequency. A

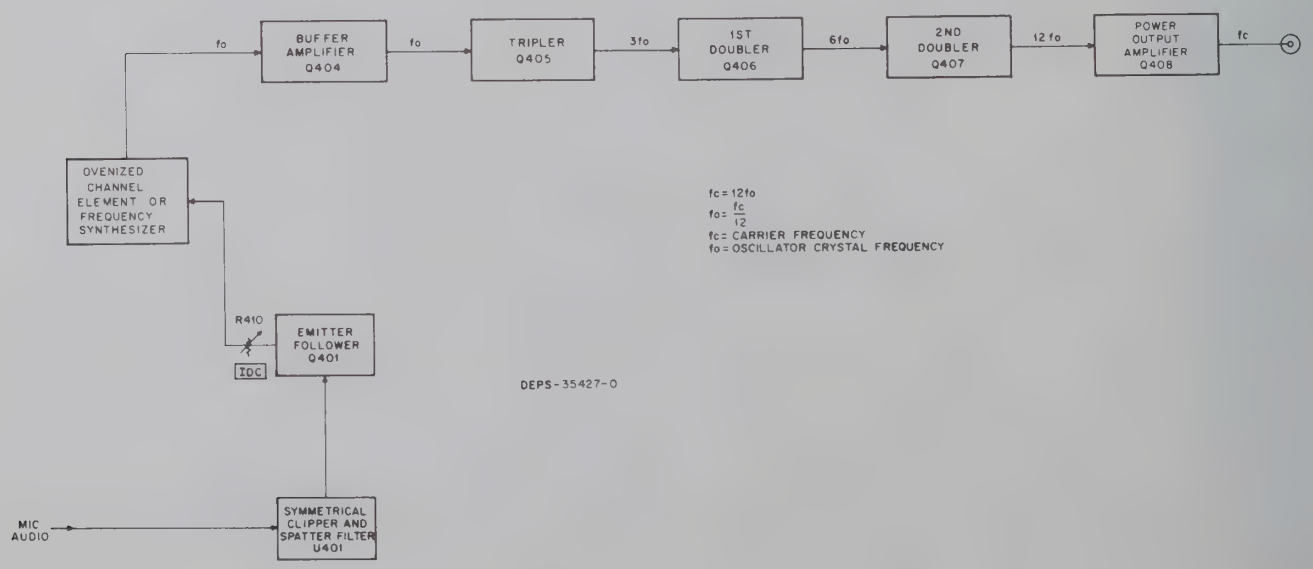


Figure 1. Exciter Block Diagram

meter connected at pin 3 of the metering receptacle measures the average dc base current which is proportional to input signal strength.

2.4.3 The first doubler circuit operates very similar to the tripler except its output is tuned to the second harmonic of its input and its drive is metered at pin 4. The output of the doubler is six times the channel element frequency.

2.4.4 The second doubler circuit also operates similar to the tripler with its output tuned to the second harmonic of its input. The drive to the second doubler is metered on pin 5 of the metering receptacle. The output signal is 12 times the channel element frequency and is the carrier frequency of the transmitter.

2.4.5 The exciter power amplifier also operates as a Class C amplifier. The amplifier provides at least 400 milliwatts of frequency modulated signal at the carrier frequency to the power amplifier section of the transmitter.

3. MAINTENANCE

3.1 METERING

The exciter is equipped with a metering receptacle which allows five major test points to be measured. The output of the exciter (input to the power amplifier) can be measured by using the metering receptacle on the power amplifier. With the portable test set connected to the metering receptacles, or by using the built-in station metering kit (if so equipped), readings may be made at each of the major test points in the circuit by merely rotating a selector switch. A failure in almost any portion of the exciter produces a low or zero meter reading for one or more of the test points. Improper alignment also causes improper meter readings.

NOTE

The exciter board must be installed in the transmitter for testing to provide the necessary power, ground, control and signal connections. The circuit board should always be secured in place with all mounting screws for operation and testing to provide good rf ground to all stages of the exciter. The exciter may be tested while installed in the station — usually the preferred method. However, if desired, it can be bench tested in a *Micor* mobile radio, except that the time-out timer is inoperative.

3.1.1 Built-In Station Metering

Step 1. The output of the exciter must be terminated into its normal point, the bandpass filter. The output of the power amplifier must be terminated in a 50-ohm dummy load or an antenna.

Step 2. Turn station ON.

Step 3. Set selector switch to position 1. Key the transmitter and whistle into the microphone long enough to observe the metering reading.

Step 4. Set selector switch to positions 2, 3, 4, and 5 respectively, keying the transmitter and observing the meter readings for each position (whistling not required). On multi-frequency stations, repeat the readings for each exciter frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows in the Performance Tests paragraph.

3.1.2 Portable Test Set

Step 1. Connect the 20-pin plug of the test set adapter cable to the test set. When the test set is not is use, disconnect the 20-pin plug to conserve battery life. The plug acts as an on-off switch completing the battery circuit.

Step 2. Connect the red "control" plug of the adapter cable to the control receptacle on the local or remote control circuit board. Connect the white "metering" plug of the adapter cable to the metering receptacle on the exciter circuit board.

Step 3. Set function selector switch to the XMTR position.

Step 4. Set oscillator and meter reversing switch to OFF postion.

Step 5. Set 1 V-100 mV switch on the adapter cable to the 100 mV position (TEK-37). On the later version adapter cable (TEK-37A), the switch is omitted and the unit operates at 100 mV sensitivity.

Step 6. Set the REF A-B switch on the adapter cable to position A.

Step 7. The output of the exciter must be terminated into its normal point, the bandpass filter. The output of the power amplifier must be terminated in a 50-ohm dummy load or an antenna.

Step 8. Turn station ON.

Step 9. Connect a microphone to the microphone receptacle on the portable test set or to the local or remote control board.

Step 10. Set selector switch to position 1. Key the transmitter and whistle into the microphone long enough to observe the meter reading.

Step 11. Set selector switch to positions 2, 3, 4, and 5 respectively, keying the transmitter with the XMTR ON pushbutton on the test set or the push-to-talk switch on

Typical Exciter Meter Readings

Selector Switch Position	Reference Switch Position (Test Set Only)	Reading	Circuit Metered	If Low, the Defective Circuit Is
1	A	2 (no mod); 6 (1 V rms @1 kHz exciter board pins 1 & 12)	Audio output of IDC circuit	IDC circuit
2	A	25	Channel element output	Channel element
3	A	38	Tripler input	Modulator or Tripler
4	A	22	1st doubler output	Tripler or 1st doubler
5	A	25	2nd doubler input	1st doubler or 2nd doubler

the microphone and observing the meter reading for each position. On multi-frequency stations, repeat the readings for each exciter frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows in the Performance Tests paragraph.

Step 12. Move the "metering" plug to the power amplifier metering receptacle and observe the meter readings for selector switch position 1. The reference A-B switch must be set to the B position and the metering reversing switch to METER REV.

Each time maintenance is performed on the exciter, the readings should be compared with the previous set of readings. Any degradation of performance will quickly be noted.

3.2 PERFORMANCE TESTS

The performance tests may be used for troubleshooting to isolate the point of abnormal performance. They may also be used after repair and alignment to assure that the exciter meets all specifications before it is returned to service.

3.2.1 Power Output Test

Step 1. Connect the equipment as connected for metering (paragraph 3.1), except connect the test set "metering" plug to the power amplifier metering receptacle.

Step 2. Set selector switch to position 1. This checks the input to the power amplifier (output of the exciter). A meter reading of at least 20 uA equals an rf signal level of 400 milliwatts.

Step 3. On multi-frequency stations of ±750 kHz separation, repeat the test for each exciter frequency. Select the frequency to be tested by the frequency selector switch associated with the station. The test set meter should indicate at least 20 uA for each frequency.

3.2.2 Frequency Test

Step 1. Terminate the transmitter in an antenna and measure the radiated signal with a Motorola digital frequency meter and deviation monitor or other highly accurate frequency measuring device (±.00005% or better).

NOTE

When high stability channel elements are used, carrier frequency must be within .0002%.

Step 2. Key the transmitter to produce an unmodulated carrier signal. In *Private-Line* tone-coded stations disable the *Private-Line* encoder by unplugging the VIBRASENDER™ resonant reed. In *Digital Private-Line* stations, disable the code by shorting together the two "code disable" pins on the PL encoder board.

NOTE

Do not use the push-to-talk switch on the microphone. Background noise will modulate the signal.

Step 3. Read the transmitter output frequency. On multi-frequency stations, repeat the test for each frequency.

Step 4. If adjustment is required, set the "warp" capacitor on the associated channel element for the assigned frequency output. For best accuracy, the radio set should be brought to room temperature (+70° to 75°F) and the test equipment thoroughly warmed up. This brings the channel element to the center of its temperature compensation range.

3.2.3 Deviation Test

Step 1. Terminate the transmitter output in an antenna and measure the radiated signal with a deviation meter.

Step 2. In *Private-Line* tone-coded squelch stations, re-insert the *Vibrasender* resonant reed if it was removed in the previous test. In *Digital Private-Line* stations, remove the code disable short. Key the transmitter with only *Private-Line* code modulation. The deviation meter should indicate 0.5 to 1 kHz.

Step 3. Connect an audio oscillator output to exciter board pins 1 (Gnd) and 12 (Audio High). Adjust the audio oscillator to 1000 Hz and 1 V as measured on an ac voltmeter. The deviation meter should indicate ±5 kHz deviation.

Step 4. Adjust the audio oscillator over the entire 300 to 3000 Hz range, keeping the audio level at approximately 1 V. The deviation meter should never exceed ±5 kHz nor drop below ±2.5 kHz.

3.2.4 Audio Sensitivity Test

Step 1. After completion of the Deviation Test, reduce the output of the audio osciillator to 130 millivolts at 1000 Hz.

Step 2. The deviation meter should indicate approximately ±3.0 kHz. Meter position 1 may be noted at this time for future reference. Future audio sensitivity checks may then be made by comparing the meter 1 reading with the reference value.

3.3 TROUBLESHOOTING

3.3.1 If there are no test set indications at one or more of the metered points, check the dc input voltages to the exciter circuit board.

P402-11 & 13	+9.6 volts in respect to chassis
P402-6	Keyed A− (approximately −13.6 volts in respect to A+, pin 7)

3.3.2 If test set indications localize the trouble to a specific stage or two, measure the dc input voltages to the suspected stages. Refer to the schematic diagram for the normal voltage.

NOTE

In *Private-Line* stations, the transmitter cannot be keyed if the PL encoder is removed unless a jumper (JU402) is connected from pin 8 to pin 10 of the exciter to complete the keying circuit. This jumper is permanently connected in exciters for non-*Private-Line* operation.

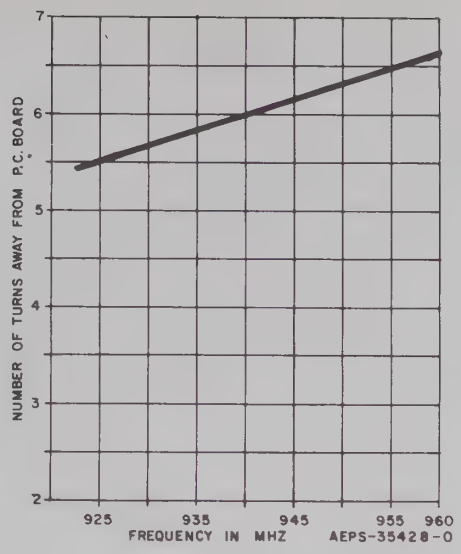
parts list

TFD6442A VHF Helical Filter — PL-8274-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor:
C1, C2	21-83406D68	27 pF; ± 5%
		coil:
L1, L2, L3	24-84418C02	rf coil
		non-referenced items
	3-134212	SCREW, tapping; 4-40 × 5/16"; 6 req'd.
	3-138081	SCREW, set; 10-32 × 1-1/16"; 3 req'd.
	7-84098K01	BRACKET, mounting
	9-82615F01	JACK, phono
	41-84410B01	SPRING, torque; 3 req'd.
	15-84097K01	HSNG CAVITY
	9-84135B02	JACK, phono
	64-84099K01	TOP, plate
	84-84100K01	Circuit Board

TRN6192A Transmitter Shield Kit — PL-8214-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-139495	SCREW, tapping; 6-32 × 5/16"; 5 used
	26-82832K01	SHIELD



Step	Adjust	Metering Plug Location	Sw
1			
2	POWER SET		
3	FREQUENCY SWITCH	EXCITER	
4	ALL EXCITER COILS	EXCITER	
5	L401	EXCITER	
6	L401, L402	EXCITER	
7	L403	EXCITER	
8	L403, L404	EXCITER	
9	L405	EXCITER	
10	L405, L406	EXCITER	
11	L407, L408	EXCITER	
12	L407, L408	PA	
13			
14			

Alignment may be performed using a Mo
metering. The OSC & METER REV
automatically reversed as required when t
thousand ohm equivalent series resistance
resistance must have their readings correct

JENCY ADJUSTMENT

mitter with the XMTR ON pushbutton on the portable test
e stations, unplug the *Vibrasender* resonant reed from the
hort together the code disable pins on the *Digital Private-*

e selected channel to the exact desired frequency. On
nt warp capacitor. On multi-frequency models, adjust the
ector switch setting; repeat for each frequency.

MENT PROCEDURES

OTE

must be measured with a Motorola R1200
iation Meter Plug-In Module that has been
1 Hz, or equivalent.

y before setting "IDC". Connect the audio oscillator to the

ne *Private-Line* models, replace the *Vibrasender* resonant
from the code disable pins.

kHz deviation.

ally full deviation should still be indicated. Less than full

parts list

TFD6442A VHF Helical Filter — PL-8274-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor:
C1, C2	21-83406D68	27 pF; ± 5%
		coil:
L1, L2, L3	24-84418C02	rf coil
		non-referenced items
	3-134212	SCREW, tapping; 4-40 × 5/16"; 6 req'd.
	3-138081	SCREW, set; 10-32 × 1-1/16"; 3 req'd.
	7-84098K01	BRACKET, mounting
	9-82615F01	JACK, phono
	41-84410B01	SPRING, torque; 3 req'd.
	15-84097K01	HSNG CAVITY
	9-84135B02	JACK, phono
	64-84099K01	TOP, plate
	84-84100K01	Circuit Board

TRN6192A Transmitter Shield Kit — PL-8214-O

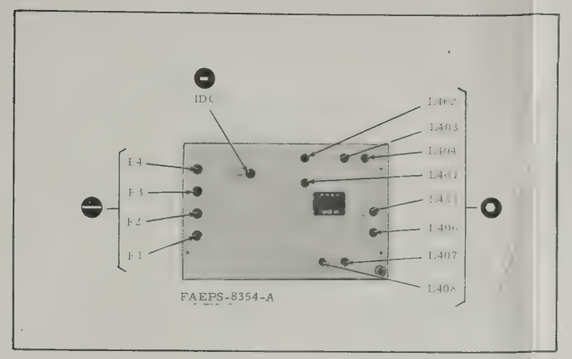
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-139495	SCREW, tapping; 6-32 × 5/16"; 5 used
	26-82832K01	SHIELD

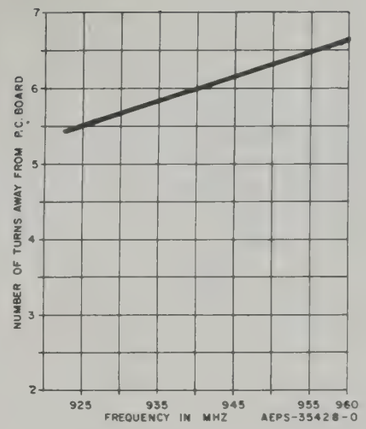
Alignment Procedure

Step	Adjust	Metering Plug Location	Selector Switch Position	Meter Rev. Switch and Ref A-B Switch (See Note)	Stage and Procedure
1					SET UP — Key the transmitter with the XMTR ON pushbutton on the portable test set.
2	POWER SET				OUTPUT — Turn the POWER SET control fully counterclockwise. Unkey the transmitter.
3	FREQUENCY SWITCH	EXCITER	2	OFF REF A	CHANNEL ELEMENT — Select the desired frequency on multi-frequency stations. Key the transmitter. The test set meter 2 should indicate at least 10 uA.
4	ALL EXCITER COILS	EXCITER	5	OFF REF A	PRE-ALIGNMENT — If the exciter is completely untuned and shows no meter 5 readings, set cores of tuning coils L401 to L406 to the top of their coil forms (away from circuit board). Set cores of L407 and L408 per the exciter pre-tuning chart. If a meter 5 reading is available proceed to Step 7.
5	L401	EXCITER	2	OFF REF A	BUFFER OUTPUT — Tune L401 for minimum meter reading.
6	L401, L402	EXCITER	3	OFF REF A	BUFFER OUTPUT — Tune L402 and then L401 for peak meter reading.
7	L403	EXCITER	3	OFF REF A	TRIPLER OUTPUT — Tune L403 for minimum meter reading.
8	L403, L404	EXCITER	4	OFF REF A	TRIPLER OUTPUT — Tune L404 and then L403 for peak meter reading.
9	L405	EXCITER	4	OFF REF A	FIRST DOUBLER OUTPUT — Tune L405 for minimum meter reading.
10	L405, L406	EXCITER	5	OFF REF A	SECOND DOUBLER OUTPUT — Tune L406, and then L405 for peak meter reading.
11	L407, L408	EXCITER	5	OFF REF A	EXCITER OUTPUT — Tune L407 then L408 for peak meter reading.
12	L407, L408	PA	1	METER REV REF A	EXCITER OUTPUT — Move the metering plug to the PA. Tune L408 and then L407 for peak meter reading.
13					Repeat Steps 6, 8 and 10.
14					Align the power amplifier.

NOTE

Alignment may be performed using a Motorola S1056 thru S1059 Portable Test Set or optional built-in station metering. The OSC & METER REV SWITCH column refers to portable test set usage — polarity is automatically reversed as required when built-in station metering is used. All meter readings are based on a two-thousand ohm equivalent series resistance in the meter. Therefore, meters not having a two-thousand ohm series resistance must have their readings corrected.





OSCILLATOR FREQUENCY ADJUSTMENT

1. Key the transmitter with no modulation (key the transmitter with the XMTR ON pushbutton on the portable test set rather than with the microphone). On *Private-Line* stations, unplug the *Vibrasender* resonant reed from the PL tone generator. On *Digital Private-Line* stations short together the code disable pins on the *Digital Private-Line* encoder board.

2. Adjust the channel element warp capacitor for the selected channel to the exact desired frequency. On single-frequency models, adjust the F1 channel element warp capacitor. On multi-frequency models, adjust the warp capacitor which corresponds to the frequency selector switch setting; repeat for each frequency.

"IDC" ADJUSTMENT PROCEDURES

NOTE

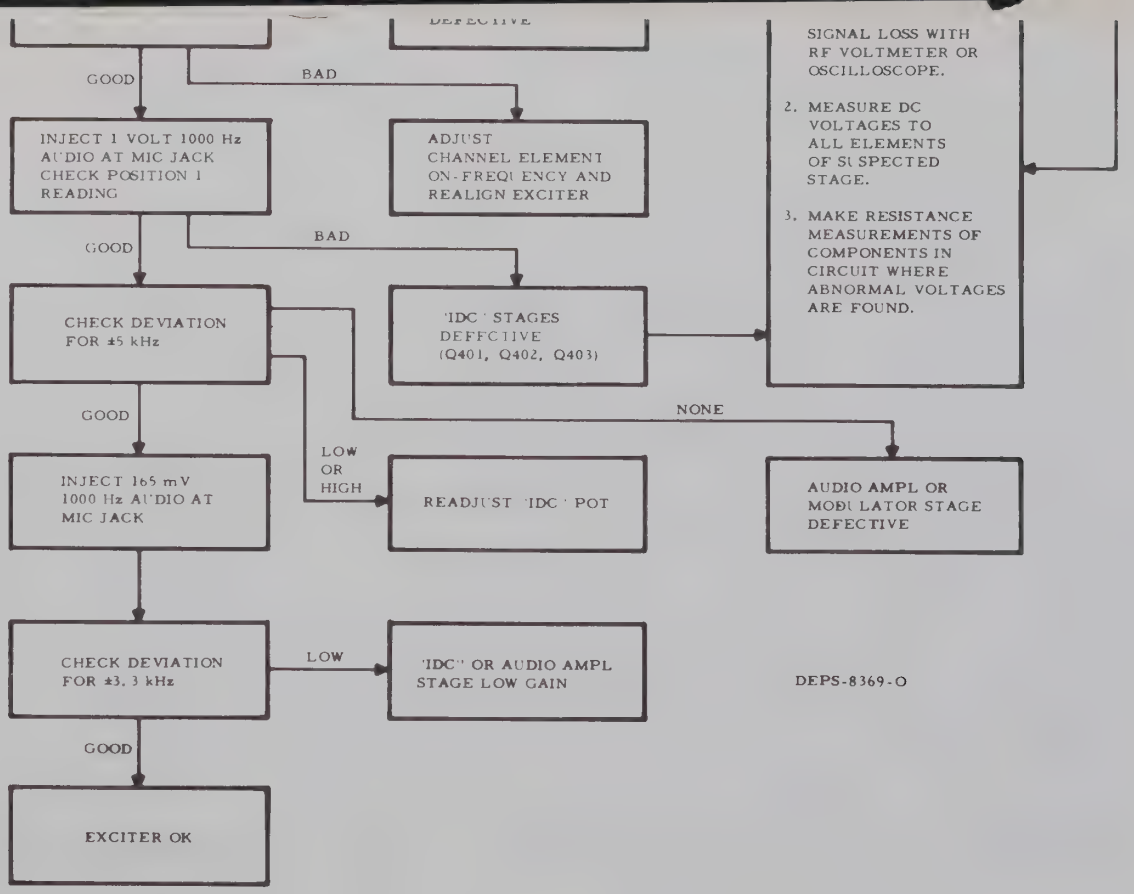
For *Digital Private-Line* stations, deviation must be measured with a Motorola R1200 Series Service Monitor with RTC-4000 Deviation Meter Plug-In Module that has been modified for frequency response of less than 1 Hz, or equivalent.

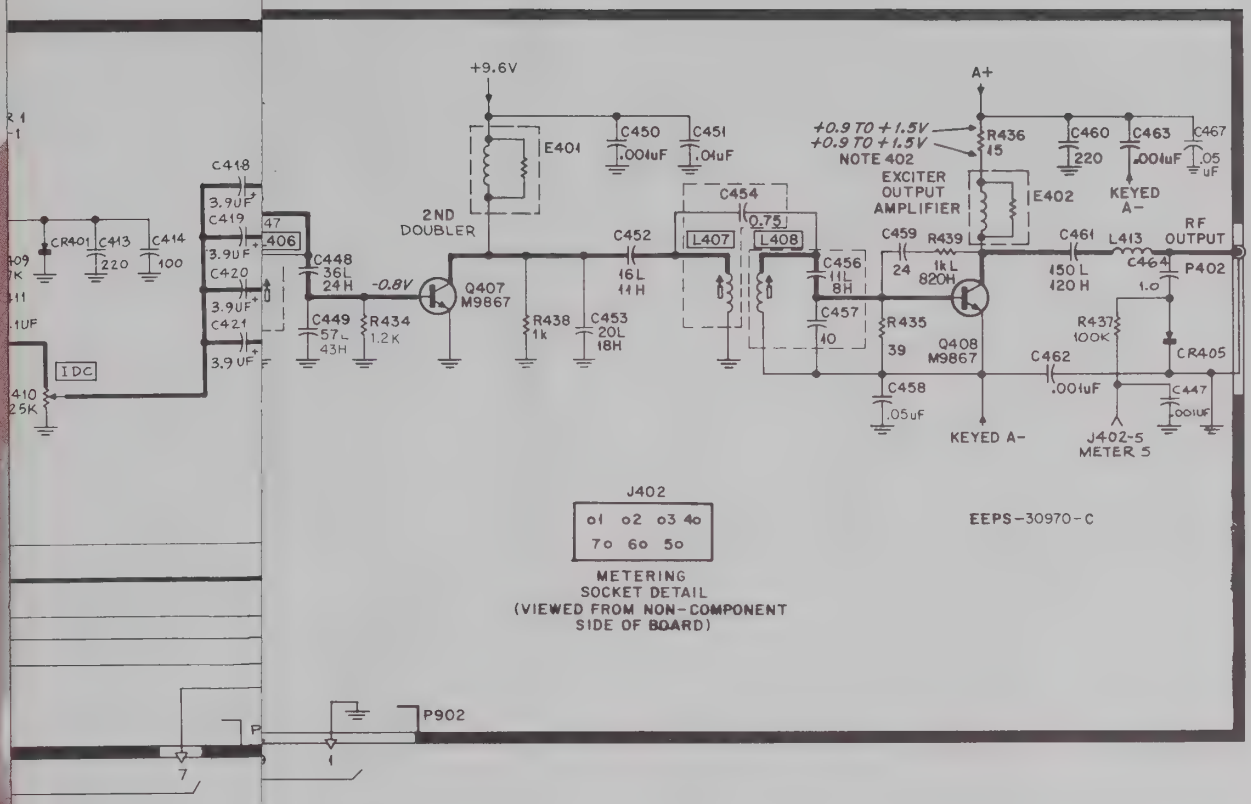
1. Each channel element must be "warped" on frequency *before* setting "IDC". Connect the audio oscillator to the exciter input (pins 1, GND, and 12, Audio High).

2. Set the audio oscillator to 1000 Hz and 1 volt. On tone *Private-Line* models, replace the *Vibrasender* resonant reed. On *Digital Private-Line* models, remove the short from the code disable pins.

3. Key the transmitter and adjust the IDC control for ±5 kHz deviation.

4. Reduce the tone oscillator output to .25 volt. Essentially full deviation should still be indicated. Less than full deviation may indicate a weak audio stage.

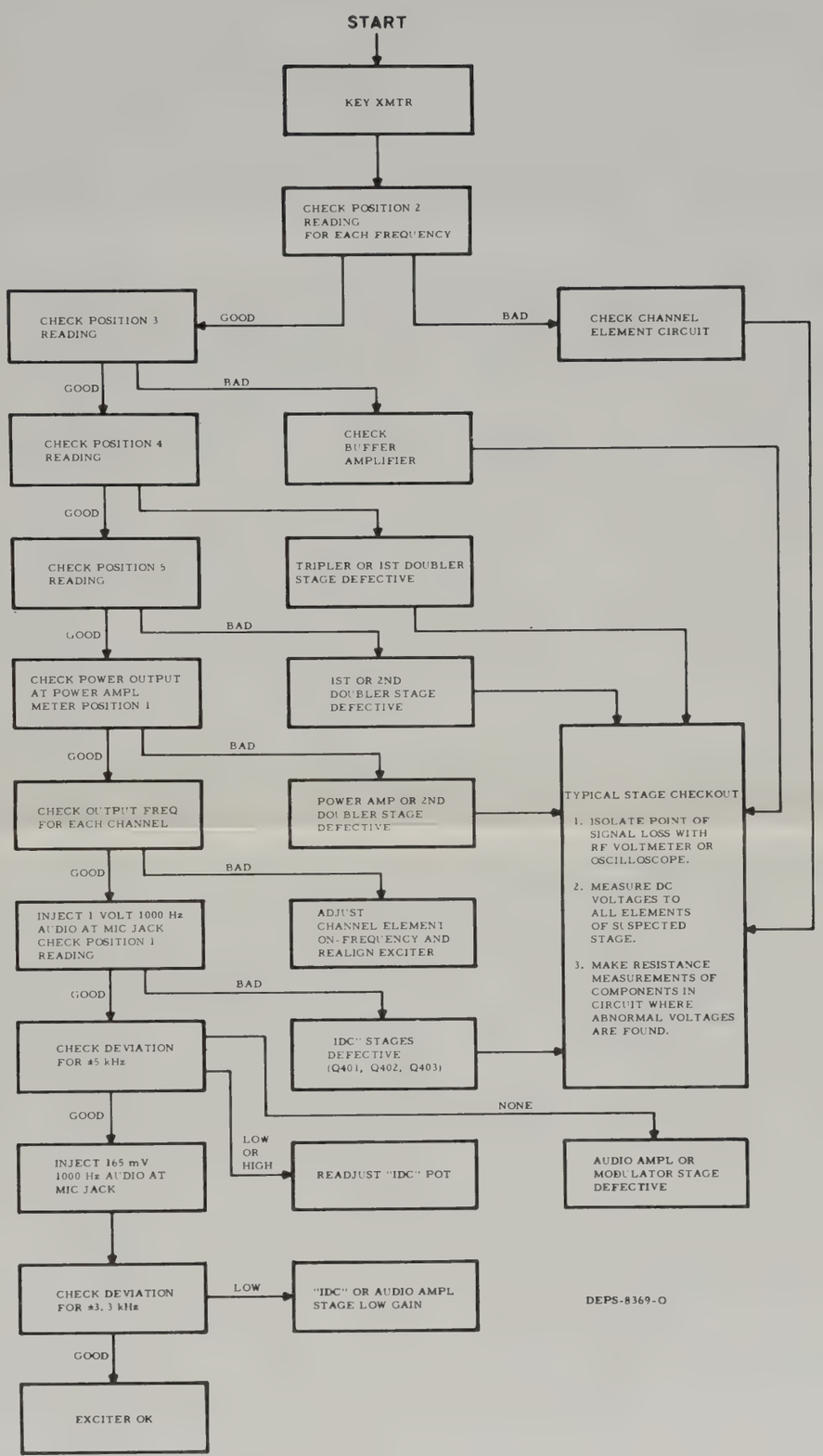

DEFECTIVE
GOOD
BAD
INJECT 1 VOLT 1000 Hz AUDIO AT MIC JACK CHECK POSITION 1 READING
ADJUST CHANNEL ELEMENT ON-FREQUENCY AND REALIGN EXCITER
GOOD
BAD
CHECK DEVIATION FOR ±5 kHz
'IDC' STAGES DEFECTIVE (Q401, Q402, Q403)
SIGNAL LOSS WITH RF VOLTMETER OR OSCILLOSCOPE.
2. MEASURE DC VOLTAGES TO ALL ELEMENTS OF SUSPECTED STAGE.
3. MAKE RESISTANCE MEASUREMENTS OF COMPONENTS IN CIRCUIT WHERE ABNORMAL VOLTAGES ARE FOUND.
GOOD
NONE
LOW OR HIGH
INJECT 165 mV 1000 Hz AUDIO AT MIC JACK
READJUST 'IDC' POT
AUDIO AMPL OR MODULATOR STAGE DEFECTIVE
CHECK DEVIATION FOR ±3.3 kHz
LOW
'IDC' OR AUDIO AMPL STAGE LOW GAIN
GOOD
EXCITER OK
DEPS-8369-O

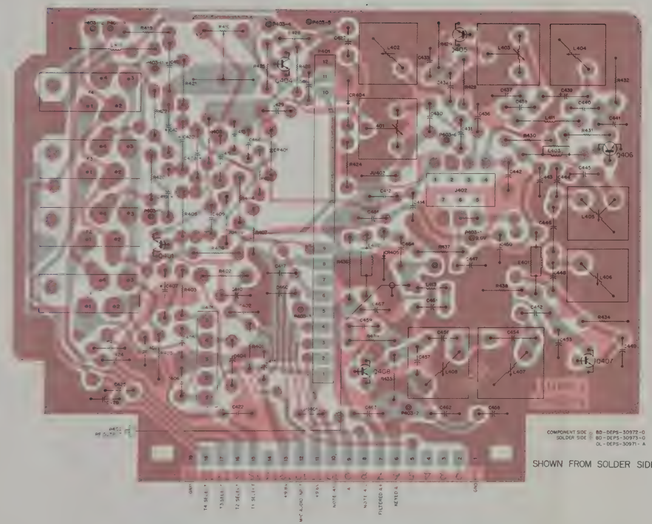


PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLD5321B and TLD5322B Exciters
Schematic Diagram and Circuit Board Detail
Motorola No. ***PEPS-30974-B***
12/1/82- UP

EXCITER TROUBLESHOOTING CHART





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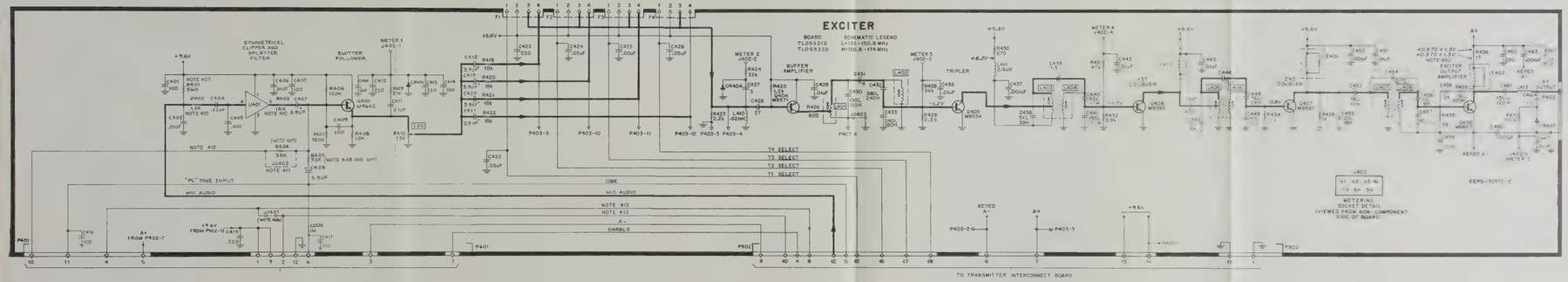


NOTES

401. Transmitter Frequency Calculation:

$$fo = \frac{fc}{12} \qquad fc = fo\ 12$$

Where
fo = Channel Element Frequency
fc = Carrier Frequency

402. Voltage measured across R436.

403. High impedance transistorized voltmeters (11 megohm) not recommended.

404. Unless otherwise stated, voltages measured in respect to chassis ground.

405. Unless otherwise stated, capacitor values are in picofarads.

406. JU401 removed in *Private-Line* and *PURC* paging radios.

407. R401 removed in remote control stations.

408. R405 is removed unless code inputs are applied via P401-6 or P902-5.

409. R404 and R405 are factory selected so that *Private-Line* deviation falls between 500 Hz and 1000 Hz limits.

410. R402 and R403 removed only in flat audio stations.

411. JU402 is added when flat audio board is used.

412.

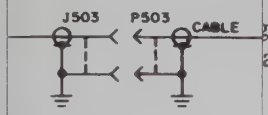
With PL Squelch Signal Name	With Flat Audio Option Signal Name
P401-10 Code Input	IDC Limited Flat Audio
P401-4, 902-8 Delayed Keyed A +	Flat Audio
P401-2, 902-10 Keyed A +	Flat Audio Control

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLD5321B and TLD5322B Exciters
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-30974-B
12/1/82-LP

TRIPLER/DOUBLER AMPLIFIER

MODEL TLF1202A



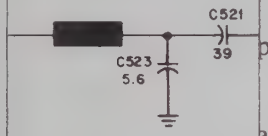
greater, the tripler/doubler
all rf cable connectors and

AMPLIFIER REMOVAL
ON PROCEDURE

TE
d from the front of

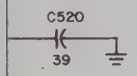
ptivated power amplifier
eat sink.

A assembly up and off the
usly disconnect the follow-



ptacle on transmitter inter-

amplifier output receptacle
r.



DEPS-35322-O

- IPA output plug from antenna network.

The PA assembly is now completely disconnected from the unified chassis and can be placed to one side.

Step 3. Loosen the three captive screws used to mount the IPA mounting bracket and remove the bracket.

Step 4. Disconnect the plug connected to TRPLR receptacle on the transmitter interconnect board.

Step 5. Loosen the four captivated screws that hold the tripler/low-level amplifier in place.

Step 6. Carefully pull out the tripler/low-level amplifier part way and then disconnect the plug connected to the output of the first bandpass filter. The tripler/doubler amplifier is now completely disconnected.

Step 7. To reinstall the tripler/doubler amplifier, reverse the procedure in Steps 1 to 6.

PARTS LIST SHOWN ON BACK OF THIS PAGE

68P81063E19-O
12/1/82- UP

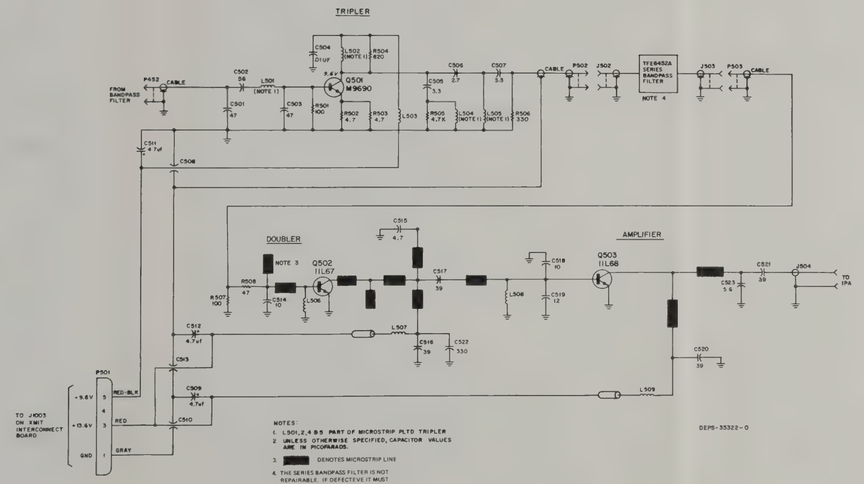
parts list

TLD5321B Exciter (132-150.8 MHz) = L
TLD5322B Exciter (150.8-174 MHz) = H

PL-7116-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
This parts list covers two models of the high band Exciter Board. Where differences exist a letter suffix L or H is added to the reference symbol to show the applicable unit.		
		capacitor, fixed: pF ±5%; 500 V unless otherwise stated
C401	21-831125	100 ± 10%; 300 V
C402	21-83596E21	.01 uF + 80-20%; 200 V
C403		NOT USED
C404	8-82905G11	.22 uF ± 10%; 50 V
C405	21-83596E13	.001 uF ± 10%; 100 V
C406	21-83596E21	.01 uF + 80-20%; 200 V
C407, 408	23-84762H08	3.9 uF ± 20%; 15 V
C409, 410	21-831125	100 ± 10%; 300 V
C411	21-82372C03	0.1 uF + 80-20%; 25 V
C412, 413, 415	21-83596E10	220 ± 20%
C414, 416, 417	21-831125	100 ± 10%; 300 V
C418 thru 421	23-84762H08	3.9 uF ± 20%; 15 V
C422	21-82372C10	.05 uF + 80-20%; 25 V
C423	21-83596E10	220 ± 10%
C424, 425, 426	21-82872C10	.05 uF + 80-20%; 25 V
C427	21-83406D51	3 ± 0.25 pF
C428	21-83406D68	27; 500 V
C429	21-83596E21	.01 uF + 80-20%; 200 V
C430L	21-84494B07	150
C430H	21-84494B06	120
C431	21-83406D54	4 ± 0.25 pF
C432L	21-84494B16	330
C432H	21-84494B13	240
C433L	21-84494B13	240
C433H	21-84494B46	180 ± 3%
C434, 435		NOT USED
C436	21-83596E21	.01 uF + 80-20%; 200 V
C437	21-83596E13	.001 uF ± 10%; 100 V
C438L	21-84494B01	51
C438H	21-84494B24	39
C439	21-861453	1.5 ± 10%
C440L	21-852322	62
C440H	21-868681	47
C441L	21-84494B10	190
C441H	21-861601	130
C442, 443	21-83596E21	.01 uF + 80-20%; 200 V
C444L	21-84493B26	22
C444H	21-83406D55	18
C445	21-82187B45	470 ± 10%
C446	21-82450B37	0.47
C447	21-83596E13	.001 uF ± 10%; 100 V
C448L	21-83406D92	36
C448H	21-83406D56	24
C449L	21-84493B31	57; 200 V
C449H	21-84494B28	43
C450	21-83596E13	.001 uF ± 10%; 100 V
C451	21-83596E21	.01 uF + 80-20%; 200 V
C452L	21-83406D93	16
C452H	21-83406D90	11
C453L	21-83406D81	20
C453H	21-83406D55	18
C454	21-82450B06	0.75 ± 10%
C455		NOT USED
C456L	21-83406D90	11
C456H	21-83406D70	8 ± 0.5 pF
C457	21-83406D89	10 ± 0.5 pF
C458	21-82372C10	.05 ± 20%; 25 V
C459	21-840365	24; NP0
C460	21-83596E10	220 ± 20%
C461L	21-84494B07	150
C461H	21-84494B06	120
C462, 463	21-83596E13	.001 uF ± 10%; 100 V
C464	21-82355B62	1.0
C465		NOT USED
C466	21-82187B06	560
C467	21-82372C10	.05 ± 20%; 25 V
		diode: (see note)
CR401	48-863030	germanium
CR402, 403		NOT USED
CR404, 405	48-82139G01	germanium
		coil, rf:
E401	24-84392B06	40 turns on 820 ohm resistor
E402L	24-84392B13	15 turns on 560 ohm resistor
E402H	24-84392B05	9 turns on 560 ohm resistor
E403L	24-84392G18	40 turns on 10k ohm resistor
E403H	24-82835G08	2.7 uH coded RED-BLU-GLD
		connector, receptacle:
J401		NOT USED
J402	9-84207B01	7 contacts
		coil, rf:
L401	24-84389B02	18-2/3 turns; coded BLK
L402	24-84389B01	18-1/2 turns; coded YEL
L403	24-84389B06	8-2/3 turns; coded GRN
L404	24-84389B05	8-1/2 turns; coded RED
L405	24-84972A33	6-1/2 turns; coded RED
L406	24-84972A09	6-1/2 turns; coded YEL
L407, 408	24-84972A11	3-1/2 turns; coded GRN
L409		NOT USED
L410	24-80900A61	0.62 mH
L411	24-82835G08	2.6 uH; coded RED-BLU-GLD
L412		NOT USED
L413H	24-84923C01	1-1/2 turns
L413L	24-84923C04	2-1/2 turns
		connector, plug:
P401		part of printed circuit board
P402	28-84282D01	phono
P403, 902		part of printed circuit board
		transistor: (see note)
Q401	48-869642	NPN; type M9642
Q402, 403		NOT USED
Q404	48-869571	PNP; type M9571
Q405	48-869534	NPN; type M9534
Q406	48-869390	NPN; type M9390
Q407, 408	48-869867	NPN; type M9867
		resistor, fixed: ±5%; 1/4 W unless otherwise stated
R401	6-124A43	560
R402	6-124A53	1.5k
R403	6-124A79	18k
R404	6-124A87 or 6-124A89	39k 47k (factory selected for DPL models only)
R405	6-124A85 or 6-124A89	33k 47k (factory selected for PL models only)
R406	6-124A99	120k
R407	6-124B04	180k
R408	6-124A73	10k
R409	6-124A83	27k
R410	18-83083G24	variable: 25k ±30%
R411 thru 418		NOT USED
R419	6-124A79	18k%
R423	6-124A57	2.2k
R424	6-124A85	33k
R425	6-124A51	1.2k
R426	6-124A47	820
R427		NOT USED
R428	6-124A87	39k
R429	6-124A57	2.2k
R430	6-124A35	270
R431	6-124A89	47k
R432	6-124A63	3.9k
R433		NOT USED
R434	6-124A51	1.2k
R435	6-124A15	39
R436	6-125C05	15 ± 10%; 1/2 W
R437	6-124A97	100k
R438	6-124A49	1k
R439L	6-124A49	1k
R439H	6-124A47	820
		symmetrical clipper and splatter filter:
U401	1-80726D74	potted unit
		non-referenced items
	14-861196	INSULATOR, transistor; 2 req'd. (used with Q407 & Q408)
	26-83379H01	HEAT SINK (used with Q408)
	26-84598A01	SHIELD, coil; 2 req'd. (used with L405, L406)
	26-84598A02	SHIELD, coil; 4 req'd. (used with L401 thru L404)
	26-84250B14	SHIELD, coil; 2 re'd. (used with L407, L408)
	42-84284B01	RETAINER; 4 req'd.
	3-139506	HEX LOCK; 4-40 x 5/8"; 4 req'd. (used for mounting Retainers)
	55-84300B01	HANDLE
	30-83794C01	CABLE, coaxial; 6" req'd. (used with P402)
	29-84028H01	TERMINAL, pin; 19 req'd.
	29-84028H02	TERMINAL, pin; 12 req'd.
	29-855943	TERMINAL, pin; 16 req'd.
	39-10184A10	CONTACT, terminal; 10 req'd.

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



1. DESCRIPTION

1.1 The function of the TLF1202A Tripler/Doubler Amplifier is to provide a ×6 multiplication factor of the exciter frequency, and to amplify the signal to a sufficient level to drive the intermediate power amplifier (IPA).

1.2 The tripler and doubler amplifier circuitry are located on two aluminum substrates. The tripler circuitry occupies a single substrate and the doubler amplifier shares a second substrate. The two substrates are housed in the chassis and hardware kit, and are interfaced with each other by the bandpass filter.

Model Complement

Model	Description
TFE6452A	Bandpass Filter
TLF6412A	Tripler/Doubler Amplifier
TRN5161A	Chassis & Hardware Kit

2. THEORY OF OPERATION

The exciter generates an rf signal in the 154.6-160 MHz range. This signal is applied to the first bandpass filter. The purpose of the first bandpass filter is to attenuate all spurious signals outside the 154.6-160 MHz frequency range. The output of the bandpass filter is routed via a coaxial cable to the tripler input Q501. The minimum signal level to the tripler input is 400 mW. The tripler circuit provides a ×3 frequency multiplication factor. The output frequency range of the tripler is 464-480 MHz. The tripler output is applied to the TFE6452A Bandpass Filter. The function of the bandpass filter is to pass signals only in the 464-480 MHz frequency range. The output of the bandpass filter is applied to the doubler amplifier input Q502. The minimum power level at the doubler amplifier input is 175 mW. The doubler amplifier provides a ×2 frequency multiplication such that the output frequency range is 928-960 MHz, a signal level of 300 mW. This signal is applied to the amplifier stage Q503 via the microstrip medium. Q503 provides signal amplification in the 928-960 MHz frequency range. The minimum signal level at the amplifier output is 1 watt. The amplifier output is interfaced with the IPA input via a coaxial cable transmission line.

3. TRIPLER/DOUBLER AMPLIFIER MAINTENANCE

NOTE

Field servicing of the tripler/doubler amplifier should not be attempted. If the tripler/doubler amplifier is defective, replace the entire unit. Removal and replacement is described following performance testing.

3.1 PERFORMANCE TESTS

Step 1. Be sure the transmitter is not keyed. Turn the Drive Limit control fully counterclockwise (minimum drive limit).

Step 2. Check all PA transistors except for those in the controlled stage for proper collector operating voltages (+13.6 volts). The controlled stage collector voltage cannot be checked until later in this procedure.

Step 3. Turn the POWER SET control fully counterclockwise (minimum power output).

Step 4. Connect a 900 MHz wattmeter to the transmitter output connector with an 8-inch or shorter length of coaxial cable. The wattmeter must be terminated in a 50-ohm resistive dummy load.

Step 5. Disconnect the transmitter output coax cable connector from the antenna network.

Step 6. Disconnect the rf connector from the output jack on the tripler/doubler amplifier. Connect the tripler/doubler amplifier output to the antenna network input using a short BNC-to-BNC adapter cable.

Step 7. Key the transmitter and check the tripler/doubler amplifier output. The wattmeter reading should be at least 1.0 watt.

Step 8. If the tripler/doubler amplifier power output is low, check exciter meter position 5. With the REF switch on the TEK-37A test set adapter cable set to B, the meter 5 reading should be at least 15 uA. If the meter 5 reading is low, the exciter is defective. If the meter 5 reading is 15 uA or greater, the tripler/doubler amplifier is bad. Also check all rf cable connectors and the bandpass filter.

3.2 TRIPLER/DOUBLER AMPLIFIER REMOVAL AND REINSTALLATION PROCEDURE

NOTE

All steps are performed from the front of the station.

Step 1. Loosen the two captivated power amplifier assembly screws on the IPA heat sink.

Step 2. Pivot and lift the PA assembly up and off the pivot bushing and simultaneously disconnect the following connectors.

- power plug from IPA receptacle on transmitter interconnect board.
- tripler plug from low level amplifier output receptacle on tripler/doubler amplifier.
- IPA output plug from antenna network.

The PA assembly is now completely disconnected from the unified chassis and can be placed to one side.

Step 3. Loosen the three captive screws used to mount the IPA mounting bracket and remove the bracket.

Step 4. Disconnect the plug connected to TRPLR receptacle on the transmitter interconnect board.

Step 5. Loosen the four captivated screws that hold the tripler/low-level amplifier in place.

Step 6. Carefully pull out the tripler/low-level amplifier part way and then disconnect the plug connected to the output of the first bandpass filter. The tripler/doubler amplifier is now completely disconnected.

Step 7. To reinstall the tripler/doubler amplifier, reverse the procedure in Steps 1 to 6.

PARTS LIST SHOWN ON BACK OF THIS PAGE

68P81063E19-O
12/1/82- UP

parts list

TRN5161A Chassis and Hardware Kit — PL-8210-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C508, 510, 513	91-87511C01	RFI, filter
		connector, receptacle:
J504	9-84968D01	bulkhead jack
		connector, plug:
P452	28-84282D01	phono, male
P501	—	consists of:
	15-83498F05	HOUSING, plug: 5-position
	29-83499F01	TERMINAL; 3 used
	46-84549F01	PLUG, polarizing
P502, 503	28-84282D01	phono, male
		mechanical parts
	1-80754D25	COVER, triple/doubler
	3-135102	SCREW, tapping: 4-40 x 1/4"; 2 used
	3-138162	SCREW, tapping: 4-40 x 3/8"; 2 used
	30-84252K01	CABLE, shielded; 1.81" used
	30-83794C01	CABLE, coaxial: 2.16" used
	42-10217A02	STRAP, tie
	42-84284B02	RETAINER; 4 used

TFE6452A Bandpass Filter — PL-8163-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		coil, rf:
L2, L3	24-84288C07	3 11/16 turns
L1, L4	24-84288C18	3 3/4 turns
		mechanical parts
	3-1438	SCREW, machine; 2-56 × 3/16; 2 req'd.
	3-7164	SCREW, machine; 6-32 × 1/4"; 4 req'd.
	3-134186	SCREW, tapping; 6-32 × 5/16"; 2 req'd.
	3-84347C01	SCREW, set; 4 req'd.
	4-852094	WASHER, insulator; 4 req'd.
	15-84246C01	HOUSING, filter box
	15-84286C01	COVER, top; filter box
	15-84289C03	COVER, bottom
	74-84287C01	FORM, coil; 4 req'd.

TLF6412A Tripler and Doubler — PL-8211-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF; 50 V: unless otherwise stated
C501	21-84873H45	47 + 5%
C502	21-84873H17	56 + 10%
C503	21-84873H45	47 + 5%
C504	21-84547A05	.01 uF ± 10%
C505	21-84736E27	3.3 ± .25 pF
C506	21-84736E26	2.7 + .25 pF
C507	21-84736E27	3.3 ± .25 pF
C509, 512	23-82783B25	4.7 uF ± 10%; 25 V
C514	21-84736E16	10 ± 5 pF
C515	21-84736E28	4.7 ± .25 pF
C516, 517	21-84873H63	39 ± 5%
C518	21-84736E16	10 ± 0.5 pF
C519	21-84736E15	12 ± 5%
C520, 521	21-84873H63	39 ± 5%
C522	21-84873H98	330 ± 10%
C523	21-84736E18	5.6 ± .25 pF
		coil, rf:
L501, 502	—	non-replaceable part
L503	24-82000E25	4-turns; coded BLU
L504, 505	—	non-replaceable part
L506	24-82723H04	0.29 uH
L507	24-82000E25	4-turns; coded BLU
L508	24-80202B01	3-turns with bead
L509	24-82000E25	4-turns; coded BLU
		resistor, fixed: ± 10%; 1/8 W: unless otherwise stated
R501	6-185B67	100
R502, 503	6-125B61	4.7 ± 5%; 1/2 W
R504	6-185B79	1k
R505	6-185B87	4.7k
R506	6-185B73	330
R507	6-185B67	100
R508	6-185B63	47
		transistor: (see note)
Q501	48-869690	NPN; type M9690
Q502	48-84411L67	NPN; type M1167
Q503	48-84411L68	NPN; type M1168
		mechanical parts
	2-84628A01	NUT, transistor mounting; 3 used
	3-7467	SCREW, tapping; 8-18 x 3/8"; 2 used
	14-83528M01	INSULATOR, right half
	14-83529M01	INSULATOR, left half
	76-83960B01	CORE, ferrite
	76-84069B01	CORE, ferrite bead; 2 used

INTERMEDIATE POWER AMPLIFIER

MODEL TLF1212A

TLF1212A Intermediate Power Amplifier Model Complement

Model	Description
TRN4847A	Heat Sink and Hardware Kit
TLF6422A	Input Amplifier
TLF6432A	Pre-driver Amplifier
TLF6442A	Driver Amplifier
TLF6452A	Final Amplifier
TLN2560A	Cable & Bracket IPA

1. TLF1212A INTERMEDIATE POWER AMPLIFIER FUNCTIONAL OPERATION

The TLF1212A Intermediate Power Amplifier (IPA) is a four stage unit consisting of two control stages, a driver stage, and a final stage. The gain of the IPA is controlled by the power control board via the directional coupler. Output signals are sampled by the power control board, which reduces or increases the drive to IPA driver stages Q601 and Q602. The IPA is protected against overdriving and high VSWR by the power control board. The output of the IPA (approximately 14 watts) is applied through a directional coupler to the 125-watt power amplifier.

2. IPA POWER SETTING PROCEDURE

NOTE

If the transmitter is to be brought back up to rated power after turning down the POWER SET control for alignment or troubleshooting procedure, proceed directly to Step 4.

Alignment Procedure

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch and Ref A-B Switch	Stage and Procedure
1	Power Set and Drive	Power Control Board	Wattmeter		Pre-setting of Controls: Adjust the drive limit control fully counterclockwise (maximum drive). Adjust the Power Set Control fully clockwise (near maximum power output). Connect a wattmeter and load to the directional coupler rf output connector and remove the shield from over the power control board.
2	Drive Limit	Power Control Board	Wattmeter		Key Transmitter. Adjust drive limit (R609 on power control board) until a power output of 20 watts is obtained. If the maximum power output is between 17 and 20 watts, set the drive limit wide open. On multi-frequency radios, check drive limit on both channels. If necessary, readjust Drive Limit control so the lowest power channel is set to 20 watts. If the Drive Limit control cannot obtain a high enough reading, set it fully counterclockwise (minimum drive limit). Unkey the transmitter and replace shield.
3	Power Set	Power Control	Wattmeter		Key the transmitter. Adjust the power set control (R607 on power control board) until power output is within the station licensing parameters (see Figures 1 & 2). On multifrequency radios, check power output on all channels. If necessary, readjust Power Set so the lowest power channel is set per Figures 1 & 2. Unkey transmitter. This completes the IPA power setting procedure.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch and Ref A-B Switch	Stage and Procedure
4	Filament Voltage	P.A.	Voltmeter		Verify standby filament voltage of 6.3 V dc Key exciter — IPA and verify that filament voltage drops to 4.8 V dc. Readjust as necessary with controls located on the power supply regulator board.

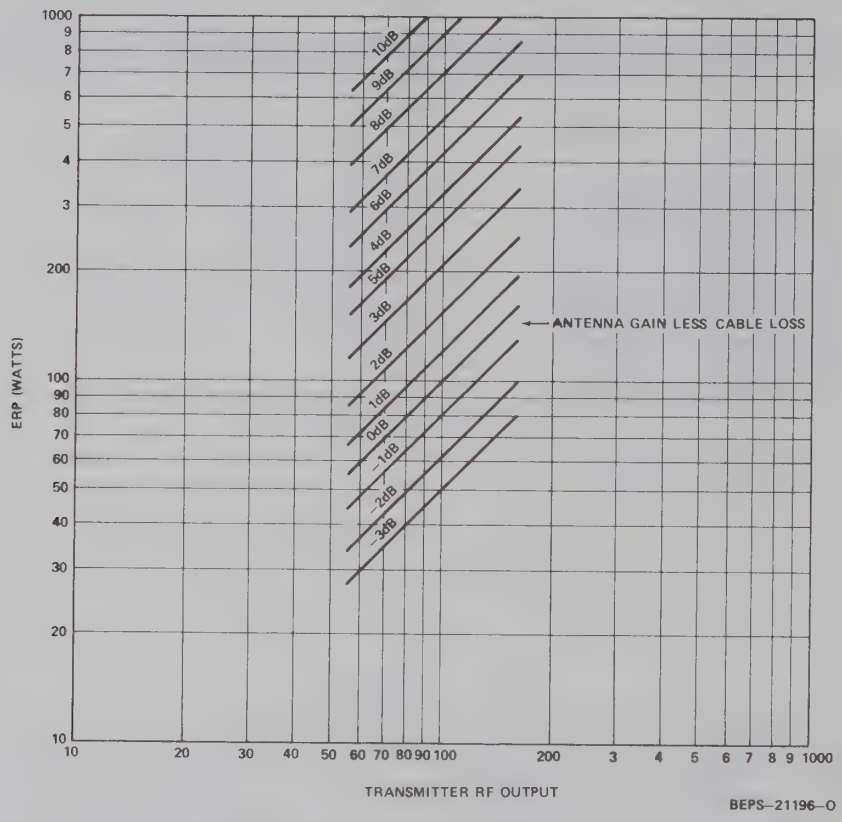


Figure 1. Effective Radiated Power

3. MAINTENANCE AND TROUBLESHOOTING

To determine if the IPA is operating properly, attach a wattmeter and a 50 ohm load to the directional coupler output.

Step 1. Key the station. Turn the power set control (R607) fully clockwise and the drive limit control (R609) fully counterclockwise (located on power control board and viewed from front of station). If power output is less than 17 watts, measure controlled A+ and A+ (blue and red wires respectively) at the IPA feedthrough terminals.

Step 2. If both of these voltages are greater than 12 volts, check input power by attaching a wattmeter and 50 ohm load to the low level amplifier output (be sure to de-key the station while the low level input amplifier is unloaded). If power is less than 1.0 watts, see sections 68P81063E19 and 68P81063E18 for tripler doubler/amplifier and exciter test procedures.

Step 3. If both controlled A+ and A+ are less than 12 volts, check fuse F1.

Step 4. If controlled A+ is less than 12 volts and A+ greater than 12 volts, check Q902 on the unified chassis and the power control board (section 68P81063E23).

Step 5. If Steps 1 through 4 have not isolated a malfunction, the fault is within the IPA. Insert a wattmeter between the tripler doubler/amplifier and the IPA. Key the station and measure the ratio of forward to reflected power. If this ratio is less than 3-to-1, the IPA input VSWR is too high. Check the input cables for breaks and/or shorts and the chip capacitors for signs of leaching. If chip capacitors and cables show no

defects, replace the input stage (TLF6422A). If cables need replacement use kit (TKN8213A).

Step 6. If input VSWR is acceptable, turn the station off and remove the rf connecting straps between the first and second stages. Connect a cable from the output of the second control stage to a wattmeter and 50 ohm load. Turn station on. After transmitter is enabled, key the transmitter. If power out of the second stage is less than 5 watts, one or both of the first stages must be replaced.

Step 7. Replace the wire removed in Step 6. Monitor the power output of the 3rd stage. If power output is less than 10 watts, replace the driver state (TLF6442A).

Step 8. Disconnect the end of the cable from the wattmeter/load and connect it to one part of a thru-line wattmeter. Connect the other end to the input circuit of the TLF6452A via a coaxial cable. Check the input VSWR of this stage as per Step 5 above.

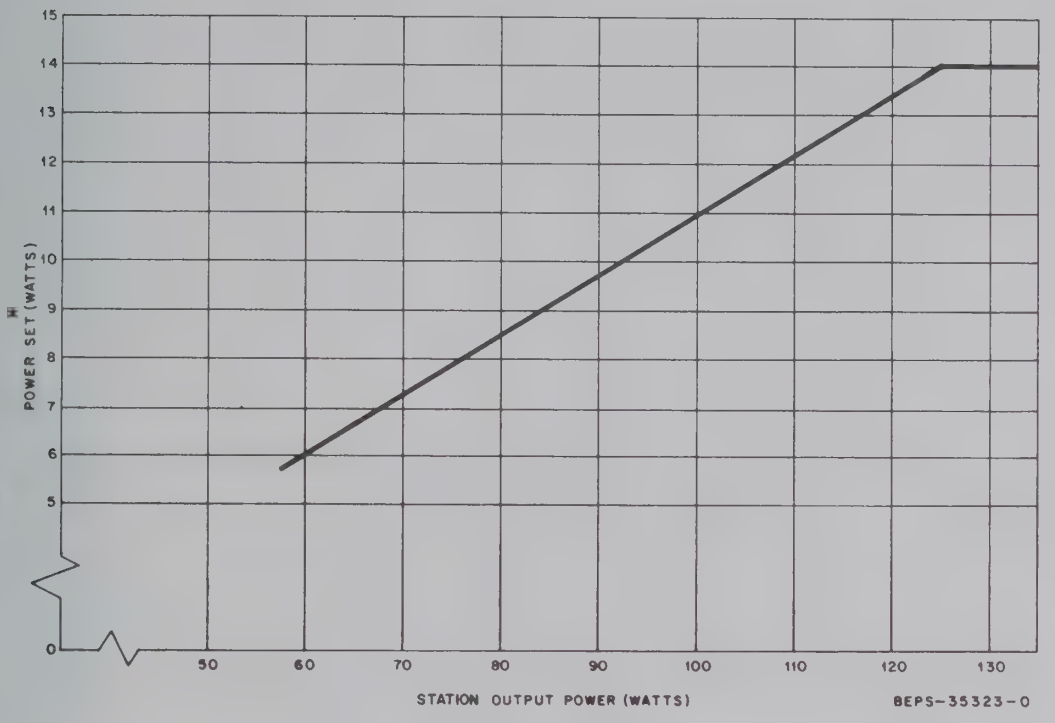
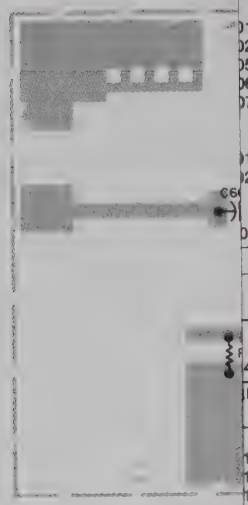


Figure 2. IPA Power Output

rts list



* DENOTES SCREEN

SHOV

422A Hybrid IPA Input Amplifier

EFERENCE SYMBOL	MOTOROLA PART NO.
01	21-84873H63
02	21-84873H64
05	21-84736E12
06	21-84547A24
07	21-84736E12
01	24-84331M02
02	24-80202B03
01	48-84411L69
	mec
	2-84628A01
	29-83208M01

432A Hybrid IPA Pre Driver Ampli

EFERENCE SYMBOL	MOTOROLA PART NO.
10, 611	21-84736E29
12, 613	21-84736E16
14	21-84547A24
15, 616	21-84736E12
17	21-84736E29
10, 611	24-80202B03
02	48-84411L70
	mec
	42-80164B01
	42-80165B01
	42-82672N01
	64-84255K03

6442A Hybrid IPA Driver Amplifier

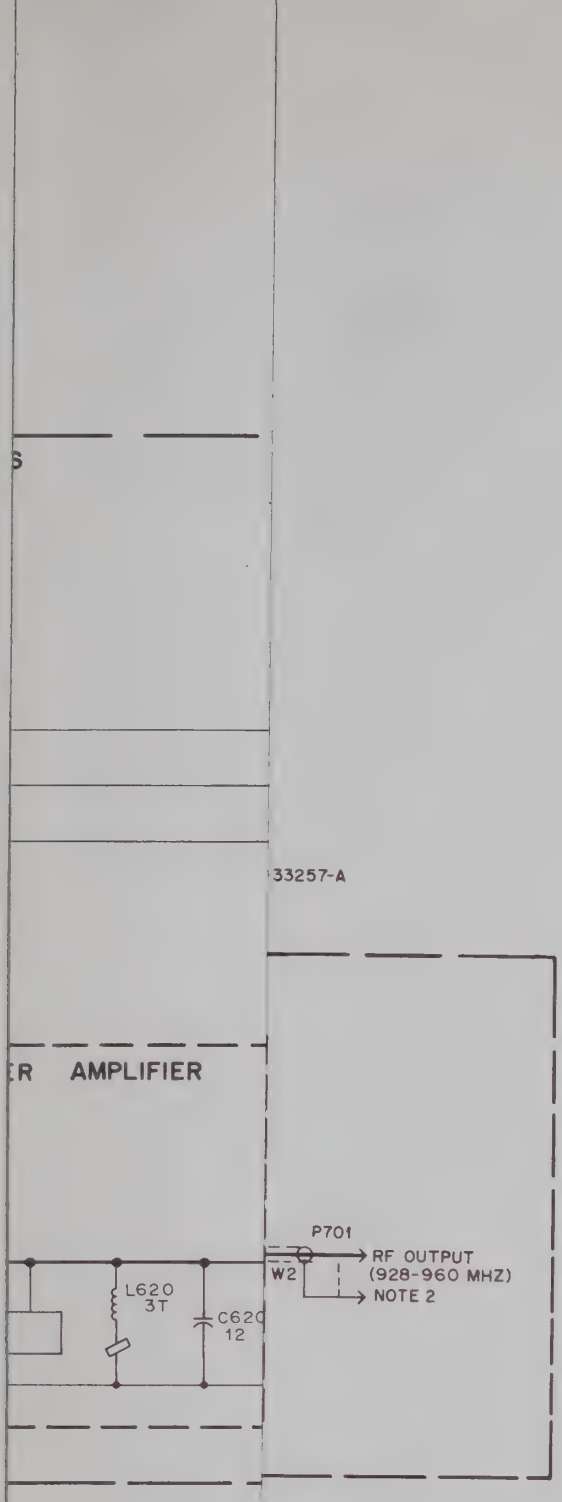
REFERENCE SYMBOL	MOTOROLA PART NO.
620 thru 623	21-84736E15
624, 625	21-84736E12
626	21-84547A24
620, 621	24-80202B01
603	48-84411L71
620	6-185B55
	mec
	29-83208M01
	42-80164B01
	42-80165B01
	42-82672N01

6452A Hybrid IPA Final Amplifier

REFERENCE SYMBOL	MOTOROLA PART NO.
630, 631	21-84736E15
632, 633	21-84736E45
634, 635	21-84736E12
630	24-80202B02
631, 632	24-80202B01
604	48-84411L72
630	6-185B55
	mec
	29-83208M01
	42-80164B01
	42-80165B01
	42-82672N01

e: For optimum performance, dic
ordered by Motorola part numbers

*TLF1212A IPA Schematic Diagram, Circuit Board Detail and Parts List Motorola No. **PEPS-35504-O** (Sheet 1 of 2)*
12/1/82-UP



NOTES:

1. Unless otherwise indicated, resistor values are in ohms and capacitor values are in picofarads.
2. IPA output power varies from 0 to greater than 14 W, depending proportionally upon the control voltage applied to the collectors of Q601 and Q602.
3. J603 used to measure Q603 and Q604 collector current, as well as collector voltage applied to Q601 and Q602. Refer to the IPA Troubleshooting Chart for normal meter readings.

TLF1212A IPA Chassis Model Complement

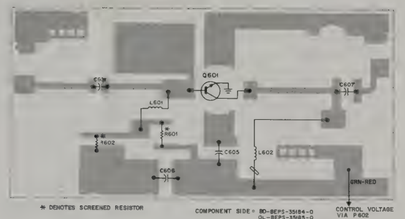
TKN8213A	IPA Cable & Metering Kit
TLF6422A	1st Controlled Amplifier Module
TLF6432A	2nd Controlled Amplifier Module
TLF6442A	Predriver Amplifier Module
TLF6452A	Driver Amplifier Module
TRN4849A	Heat Sink & Hardware Kit

NOTE

Modules are not field repairable. Order replacement by kit number, TLFXXXX.

TLF1212A IPA Schematic Diagram, Circuit Board Detail and Parts List Motorola No. PEPS-35504-O (Sheet 2 of 2)
12/1/82- UP

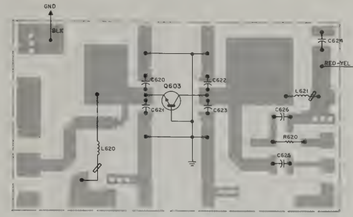
TLF6422A INPUT AMPLIFIER



* DENOTES SCREENED RESISTOR

SHOWN FROM COMPONENT SIDE

TLF6442A DRIVER AMPLIFIER



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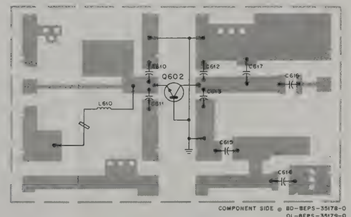
TLF6432A PRE-DRIVER AMPLIFIER



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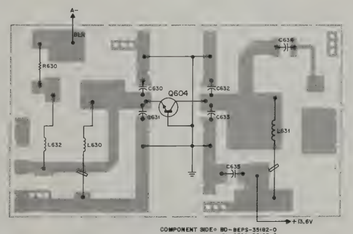
TLF6452A HYBRID IPA FINAL AMPLIFIER



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TLF1212A IPA Schematic Diagram, Circuit Board Detail and Parts List Motorola No. PEPS-35504-O (Sheet 1 of 2)
12/1/82-UP

parts list

TLF6422A Hybrid IPA Input Amplifier — PL-8159-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C601	21-84873H83	39 pF ± 5%; 50 V
C602	21-84873H64	4.3 pF ± .25; 50 V
C605	21-84736E12	39 pF ± 5%; 50 V
C606	21-84547A24	0.1 uF ± 20%; 25 V
C607	21-84736E12	39 pF ± 5%; 50 V
		coil, rf:
L601	24-84331M02	3 turns
L602	24-80202B03	3 turns
		transistor: (see note)
Q601	48-84411L69	NPN; type M1169
		mechanical parts
	2-84628A01	NUT, transistor mounting
	29-83206M01	LUG, soldering

TLF6432A Hybrid IPA Pre Driver Amplifier — PL-8160-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C610, 611	21-84736E29	7.5 pF ± 0.25 pF; 50 V
C612, 613	21-84736E18	10 pF ± 0.5 pF; 50 V
C614	21-84547A24	.01 uF ± 20%; 25 V
C615, 616	21-84736E12	39 pF ± 5%; 50 V
C617	21-84736E29	7.5 pF ± 0.25 pF; 50 V
		coil, rf:
L610, 611	24-80202B03	3 turns
		transistor: (see note)
Q602	48-84411L70	NPN; type M1170
		mechanical parts
	42-80184B01	RETAINER
	42-80185B01	CLIP, retainer (2 used)
	42-82572N01	STRAP, connecting
	64-84255K03	PLATE, ground strap

TLF6442A Hybrid IPA Driver Amplifier — PL-8161-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C620 thru 623	21-84736E15	12 pF ± 5%; 50 V
C624, 625	21-84736E12	39 pF ± 5%; 50 V
C626	21-84547A24	0.1 uF ± 20%; 25 V
		coil, rf:
L620, 621	24-80202B01	3 turns
		transistor: (see note)
Q603	48-84411L71	NPN; type M1171
		resistor, fixed:
R620	6-185B55	10 ± 10%; 1/8 W
		mechanical parts
	29-83206M01	LUG, soldering; 2 used
	42-80184B01	RETAINER, driver
	42-80185B01	CLIP, retainer; 2 used
	42-82572N01	STRAP, connector

TLF6452A Hybrid IPA Final Amplifier — PL-8162-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C630, 631	21-84736E15	12 pF ± 5%; 50 V
C632, 633	21-84736E45	14 pF ± 5%; 50 V
C634, 635	21-84736E12	39 pF ± 5%; 50 V
		coil, rf:
L630	24-80202B02	3 turns
L631, 632	24-80202B01	3 turns
		transistor: (see note)
Q604	48-84411L72	NPN; type M1172
		resistor, fixed:
R630	6-185B55	10 ± 10%; 1/8 W
		mechanical parts
	29-83206M01	LUG, soldering; 2 used
	42-80184B01	RETAINER, driver
	42-80185B01	CLIP, retainer; 2 used
	42-82572N01	STRAP, connector

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers

TRN4848A Heat Sink and Hardware IPA — PL-8207-O

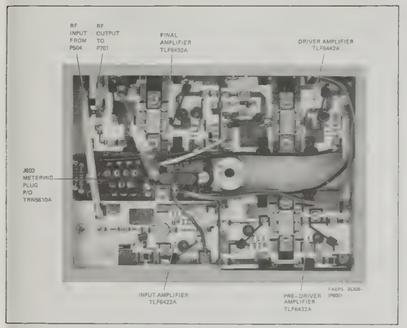
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-118032	SCREW, machine; 10-32 x 1"; 2 used
	3-124432	SCREW, machine, 4-40 x 1/4"; 11 used
	3-128674	SCREW, machine; 4-40 x 3/16"; 2 used
	3-135084	SCREW, tapping; 4-40 x 5/16"; 8 used
	3-135960	SCREW, tapping; 10-32 x 1/2"; 2 used
	3-136851	SCREW, machine; 10-32 x 3/8"
	3-136886	SCREW, machine; 4-40 x 3/8"
	14-82538N01	INSULATOR, heat sink
	15-82348N01	COVER, IPA, heat sink
	26-82349N01	HEAT SINK
	30-83794C01	CABLE, coaxial; WHT; 2.2"
	32-82532M02	GASKET, RFI cover
	42-10128A10	RETAINER, ring; 3 used
	42-10217A15	STRAP, tie
	42-84410M02	STRAP, PA; 5 used
	43-10646A09	STANDOFF, 4-40 x .188; 2 used
	43-82525N01	BUSHING; 2 used
	43-82345N01	STAND OFF (feed-thru)

TKN8213A Cable DC and Bracket IPA — PL-8164-O

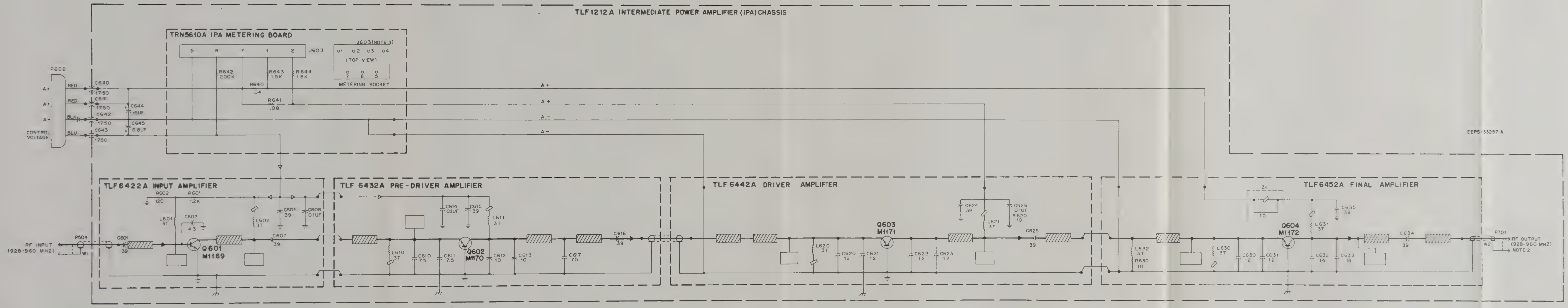
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		filter, RFI:
C640 thru 643	91-87511C01	1750 pF; 125 V
C644	23-83214C26	10 uF
C645	23-83214C21	6.8 uF
		connector, plug:
P504	28-83099K01	male, single contact
P602	15-83498P07	housing, 6-contact
P701	28-83099K01	male, single contact
	42-10217A01	strap, tie
		cable:
W1	1-80781D57	Assembly cable coaxial input; includes:
	30-83794C01	CABLE, coaxial; 10" used
	37-82903D01	SLEEVING, coded #1 and refer P504
W2	1-80761D58	Assembly cable coaxial out includes:
	30-83794C01	CABLE, coaxial; 10.34" used
	37-82903D02	SLEEVING, coded #2 and refer. P701
W3	1-80761D76	Assembly cable with connector; includes:
	29-83498F01	TERMINAL; 4 used
	42-10217A02	STRAP, tie
	48-84549P01	PLUG, polarizing and refer. P602
		mechanical parts
	7-82344N01	BRACKET, feed-thru
	42-10217A15	STRAP, tie

TRN5610A IPA Metering Board — PL-8183-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J803	9-84207B01	**connector, receptacle:** female; 7-contact
		resistor, fixed:
R640	6-84415K02	.04 ± 5%; 2.5 amp
R641	17-82300A14	.08 ± 10%; 1 W
R642	6-11009F05	200k ± 5%; 1/4 W
R643	6-11009C53	1.5k ± 5%; 1/4 W
R644	6-11009C55	1.8k ± 5%; 1/4 W
Z1	1-80736D19	Assembly bead & resistor; Includes:
	6-125C01	10 ± 10%; 1/2 W
	76-84069B01	ferrite bead



IPA BOARD IDENTIFICATION



NOTES:

1. Unless otherwise indicated, resistor values are in ohms and capacitor values are in p[illegible]farads.
2. IPA output power varies from [illegible] greater than 14 W, depending proportionally upon the [illegible] voltage applied [illegible] the [illegible] of Q601 and Q602.
3. J603 used to measure Q603 and Q604 [illegible] current as well as [illegible] voltage applied to Q601 and Q602. Refer to the IPA Troubleshooting Chart for normal meter readings.

TLF1212A IPA Chassis Model Complement

TKN8213A	IPA Cable & Metering Kit
TLF6422A	1st Controlled Amplifier Module
TLF6432A	2nd Controlled Amplifier Module
TLF6442A	Predriver Amplifier Module
TLF6452A	Driver Amplifier Module
TRN4849A	Heat Sink & Hardware Kit

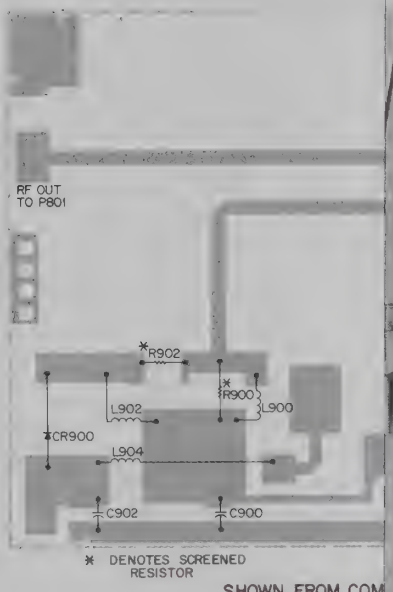
NOTE
Modules are not field repairable. Order replacement by kit number TLFxxxx.

TLF1212A IPA Schematic Diagram, Circuit Board Detail and Parts List
Motorola No. PEPS-35504-O
(Sheet 2 of 2)
12/1/82-UP

DIRECTIONAL COUPLER
MODEL TLF1232A

1. FUNCTIONAL OPERATION

The TLF1232A Directional Coupler samples both
forward and reverse power of the intermediate power
amplifier. A sample of forward and reverse power is
detected by CR900 and CR901 and sent, as a dc control
voltage, to the power control board. The power control



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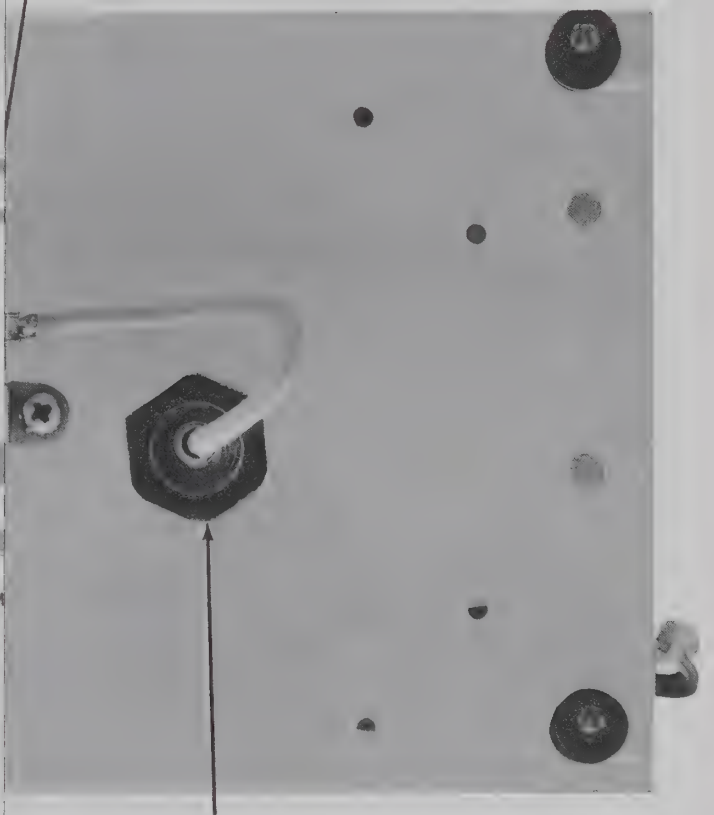


RD
GE
OR

BOARD

parts list

TRN4989A Hybrid Directional Coupler PL-8167-

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C900 thru 904	21-84873H63	39 pF ± 5%
		diode: (see note)
CR900, 901	48-84616A07	hot carrier
		coil, rf:
L900, 901	24-83035N11	11 turns
L902, 903	24-84331M47	7 turns
L904, 905	24-82723H40	choke; 0.29 uH
		mechanical parts
	7-84198N01	FRAME
	29-83208M01	LUG, soldering; 3 used

note: For optimum performance, diodes, transistors, and integrated circuits mus
be ordered by Motorola part numbers.

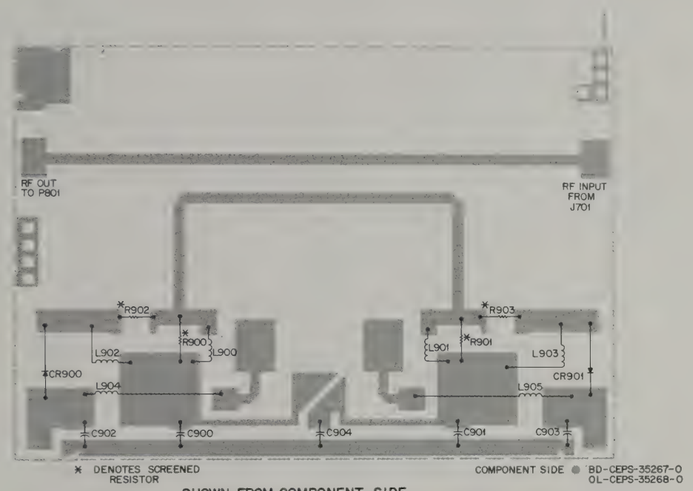
COMPONENT LOCATION

1. FUNCTIONAL OPERATION

The TLF1232A Directional Coupler samples both forward and reverse power of the intermediate power amplifier. A sample of forward and reverse power is detected by CR900 and CR901 and sent, as a dc control voltage, to the power control board. The power control board uses these voltages to control the output of the IPA and thus the output of the transmitter.

2. MAINTENANCE AND TROUBLESHOOTING

The directional coupler contains hybrid microstrip circuitry and should be considered a non-repairable item.



SHOWN FROM COMPONENT SIDE

parts list

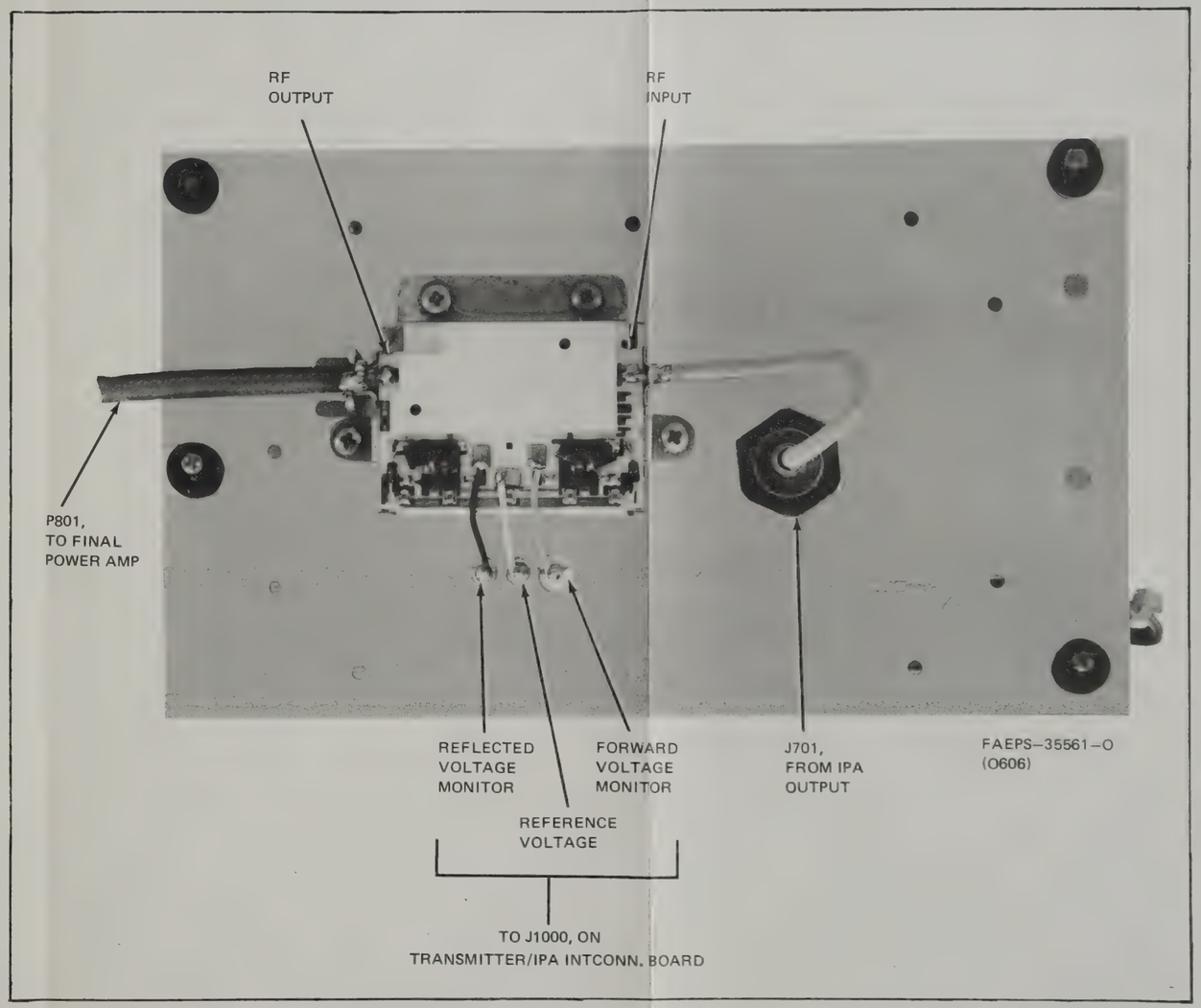
TRN4989A Hybrid Directional Coupler — PL-8167-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C900 thru 904	21-84873H63	39 pF ± 5%
		diode: (see note)
CR900, 901	48-84616A07	hot carrier
		coil, rf:
L900, 901	24-83035N11	11 turns
L902, 903	24-84331M47	7 turns
L904, 905	24-82723H40	choke; 0.29 uH
		mechanical parts
	7-84198N01	FRAME
	29-83208M01	LUG, soldering; 3 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TKN8226A Cable and Hardware Coupler — PL-8182-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
P1000	15-83498F06	housing; 6-contact
J701	9-84968D01	female; single contact
		connector, plug:
P907	28-852527	male, single contact
		mechanical parts
	3-134169	SCREW, tapping: 4-40 × 1/4"; 10 used
	3-138162	SCREW, tapping: 4-40 × 3/8"; 4 used
	15-82045L02	COVER, directional coupler
	42-10217A02	STRAP, tie .091 × 3.62; 4 used
	1-80738D18	CABLE ASSY, dc
	42-84284B01	RETAINER; 4 used
	29-83499F01	TERMINAL; 3 used
	46-84549F01	PLUG; polarizing
	1-80761D36	Assembly directional coupler feed-thru includes:
	1-80761D35	Assembly plate coupler mounting includes:
	5-84500B03	EYELET, special; (4 used)
	64-82428N01	PLATE, coupler
	91-87511C01	FILTER RF1
	1-80761D34	Assembly cable rf coupler out; includes ref. P907
	30-84173E01	CABLE, coaxial; 14" used
	1-80740D66	Assembly cable coupler; includes ref J701
	30-83794C01	CABLE, coaxial; 4 1/4" used
	3-135102	SCREW, tapping: 4-40 × 1/4"; 4 used



DIRECTIONAL COUPLER COMPONENT LOCATION

68P81063E22-O
12/1/82- *UP*

POWER CONTROL BOARD

MODEL TRN4845A

1. DESCRIPTION

The power control board operates as a control loop which continually monitors the output of the intermediate power amplifier (IPA) and controls that output by regulating the collector voltage applied to the IPA controlled stage.

2. CONTROL THEORY

2.1 GENERAL

Two integrated circuits are used to develop the control functions. Reflected voltage is amplified by IC602, which controls the bias to IC601. This amplified voltage and the forward voltage are compared by IC601. The output of IC601 (through Q601) regulates the base current to control stage Q902 (mounted on the unified chassis) which is used to bias the IPA driver stage.

2.2 VSWR PROTECTION CIRCUITRY

When the VSWR approaches 2.5:1, forward power from the IPA must be reduced to prevent IPA oscillation or damage. During normal operation, the voltage at J1004-3 (reflected) and J1004-2 (reference) is approximately 5 volts, producing a 5 volt output from IC602. Since the voltage at pin 5 of IC601 is normally 5.5 volts (with 14 watts of output from the IPA), CR604 is reverse biased. When excessive VSWR is present, the voltage at J1004-3 drops, causing the voltage at pin 6 of IC602 to increase. When the potential at pin 6 reaches a sufficiently high level, CR604 conducts (reflected voltage at J1004-3 remains constant and forward voltage at J1004-4 decreases as VSWR increases). When CR604 becomes forward biased, the voltage at pin 5 of IC601 increases and pin 8 becomes more positive, decreasing the drive to Q902 thus lowering the control voltage to the IPA.

3. POWER CONTROL BOARD MAINTENANCE

NOTE

The power control board must be installed in a transmitter for testing to provide the necessary power, ground, and control connections. For bench testing of a board that has been removed from the radio set and replaced by a spare, another radio set is required as a test fixture for troubleshooting.

3.1 PERFORMANCE TESTS

3.1.1 Power Set Control Test

This control allows the power output of the IPA to be varied from zero (0) power out with the control fully counterclockwise to greater than the rated output. Refer to the intermediate power amplifier section of this manual.

CAUTION

For proper operation of the protection circuitry, it is imperative that the POWER SET control never be left in a position that exceeds rated power output.

Step 1. Key the transmitter.

Step 2. Adjust the POWER SET control until the rated power output is reached. Refer to the Power Setting Procedure in the Intermediate Power Amplifier section of this manual.

Step 3. Unkey the transmitter.

3.1.2 Drive Limit Control

3.1.2.1 This control allows the drive power to the power amplifier from the controlled stage to be limited to a level sufficient to provide rated performance. Its purpose is to set a limit on the drive power that can be called for by the automatic power leveling circuitry. This prevents earlier IPA stages from being damaged by overdrive if later stages fail. Depending on the position of the Drive Limit Control, the maximum collector voltage of the controlled stage can be limited to between 6.5 volts and 12.5 volts. The proper procedure for setting the Drive Limit Control is given in the Intermediate Power Amplifier section of this manual.

CAUTION

For proper operation of the power leveling circuitry, the Drive Limit control *must not* be set for any lower output than that given in the IPA section of this manual.

3.1.2.2 In some stations, the power leveling circuitry may operate the controlled stage at a collector voltage more than 12 volts. In such stations, little or no effect will be seen from the Drive Limit Control. If it is not possible to lower power output by the Drive Limit Control to the level called for, set the Drive Limit Control to its maximum clockwise position (maximum drive limits).

4. TROUBLESHOOTING

4.1 GENERAL

Efficient location of power control board faults requires a thorough knowledge of theory of operation. In any case, it is a good idea to review theory and the schematic diagram before performing troubleshooting procedures.

4.2 PROCEDURE

Step 1. Couple the IPA into a through-line wattmeter and a 50 ohm load to the directional coupler.

Step 2. Perform the power set control and Drive Limit Control tests given in paragraph 3. If the power control board does not control the IPA, proceed to Step 3. If there is no IPA power output, proceed to Step 4.

Step 3. If the power control board does not control or level IPA power, turn R609 fully counterclockwise and R607 fully clockwise (with respect to solder side). Key the station and read meter position 1 on the station metering kit or portable test set.

A. If the reading is less than 5.0 uA, inspect the wiring from the directional coupler to the transmitter interconnect board. If wiring is proper, check R610 and proceed to Step 3C.

B. Key the station. Measure and record the following directional coupler voltages:

voltage at white lead _____
voltage at yellow lead _____

If the voltage at the white lead is not between 4.5 and 6.0 volts, proceed to Step 3C. If the voltage at the white lead is between 4.5 and 6.0 volts and the voltage at the yellow lead is less than 4.5 volts, the problem is in the directional coupler (see section 68P81063E22). If the voltage at the white lead is between 4.5 and 6.0 volts and the voltage at the yellow lead is greater than 4.5 volts, look for broken wires or plating on the transmitter interconnect board.

C. Measure the voltage at the anode of CR607. If the voltage is not between 4.5 and 6.0 volts, check the voltage at the emitter of Q602 (8.3 volts ±20%).

D. Measure the voltage at pin 1 of IC601. If the voltage is greater than 7 volts, check R604, R617, CR606, CR605, and R613.

E. Remove F1 on the unified chassis (7.5 amp). Key the station and measure the voltage at pin 5 of IC601 while varying R607 from minimum to maximum. If pin 5 does not vary from approximately 2.0 to 6.0 volts, check R605, R606, and R607. Reconnect F1.

F. Turn R609 fully counterclockwise. Key the station and, while varying R607 from maximum to minimum, measure the voltage at pin 8 of IC601. If pin 8 does not vary from 2 to 11 volts, check Q601 and, if good, replace IC601 (IC601 is usually malfunctioning if this occurs).

G. Key the station. Measure the voltage at the emitter of Q601 while varying R607. If the voltage does not vary from 3 to 14 volts, check Q601, Q902 (on transmitter interconnect board), and CR601.

Step 4. If there is no power output from the IPA:

A. Terminate the triper/doubler amplifier into a wattmeter and a 50 ohm load. Power output should be greater than 1.3 watts. If less than 1.3 watts, check the tripler and doubler and the exciter. Reconnect the tripler/doubler amplifier to the IPA.

B. Turn R607 fully clockwise and R609 fully counterclockwise. Key the station and measure the voltages at the IPA input. Both the blue and red wire leads should be between 11 and 16 volts. If red lead is less than 11 volts, inspect F1 on the unified chassis, the power supply, and the plating on the transmitter interconnect board. If the blue lead is less than 11 volts, proceed to Step 4C. If both red and blue leads are greater than 11 volts

and there is still no power output, the IPA is faulty and/or there is no input power.

C. Key the station and measure the voltage at the cathode of CR609. If less than 11 volts, check CR609 and the 9.6 and 13.6 volt regulator board on the low voltage power supply.

D. Insure that the station is unkeyed and measure the voltage at the collector of Q601. The voltage should be greater than 11 volts. Key the station. If the voltage at Q601 collector does not drop to 0.3 volts, check the station control module.

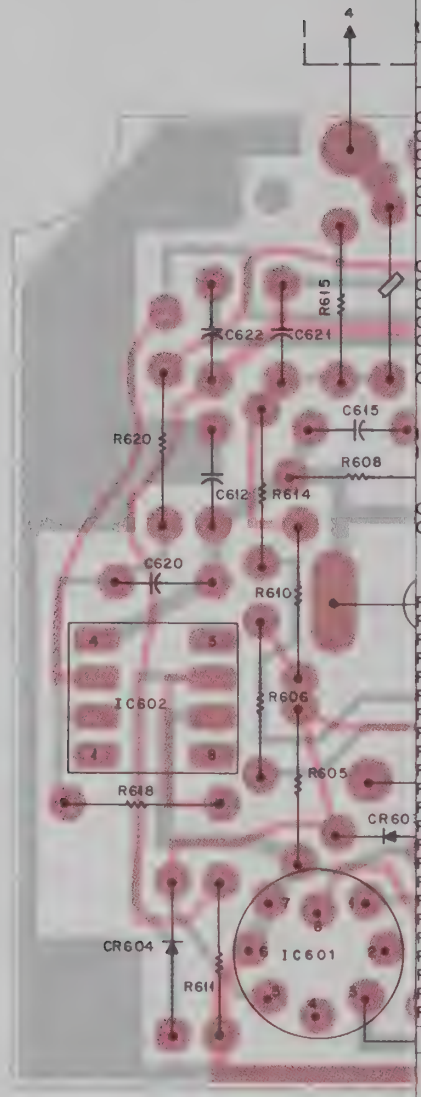
E. Key the station and measure the voltage at the emitter of Q602. If not 8.2 volts ±20%, check Q602 and CR602.

F. Short out R604 and key the station. If power from the IPA is still zero, check pin 8 of IC601. If greater than 5 volts, replace IC601. Measure the voltage at the emitter of Q601. If greater than 5 volts, check R908, CR601, R603, and Q601.

Step 5. If the power control board does not limit the drive to the IPA, set the IPA power output at 14 watts (R607). Read power control board meter position 5. This reading will vary but in all cases should be less than 38 uA. If less than 38 uA, check CR603 and R609. If greater than 38 uA, check CR610.

Step 6. If there is no power cutback under excessive VSWR conditions, remove the lead of R618 that connects with J1004-3. Connect this lead to a 0-6 volt variable power supply and terminate the IPA into a 50 ohm load. Key the station and adjust the power supply to 6.0 volts. Adjust R607 until 14 watts of output power is obtained from the IPA. If output power cannot be varied, check CR604 and R607. Vary the 0-6 volt power supply. IPA output power should increase and decrease smoothly. If power drops abruptly, check R618 and R620. If no power change is noticed, replace U602.

arts list



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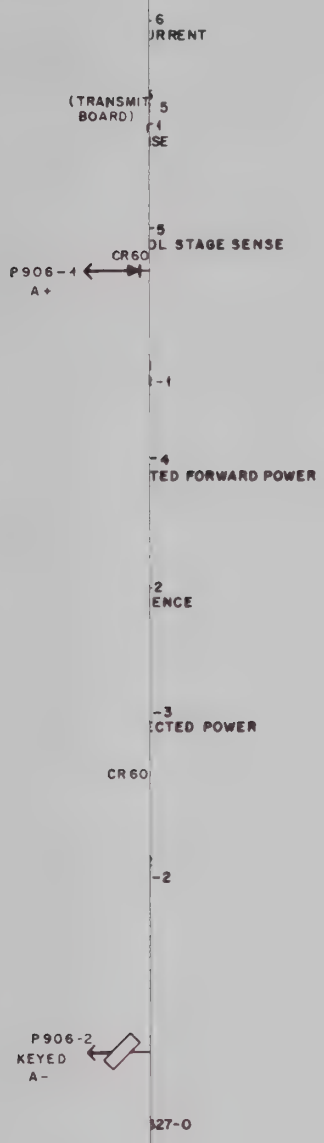
TN4845A Power Control Board — PL-8195-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C602 thru 605	21-82355B39	4.7 pF; 0.25 pF; 500 V
C606	23-84538G08	2.2 uF ± 20%; 20 V
C608 thru 622	21-82355B39	4.7 pF; 0.25 pF; 500 V
C623	21-82372C07	.05 uF + 80-20%; 25 V
C624, 625	21-82355B39	4.7 pF; 0.25 pF; 500 V
C626	23-82783B48	0.68 uF ± 10%
		diode: (see note)
CR601	48-83654H01	silicon
CR602	48-83696E04	silicon
CR603	48-4616A01	hot carrier
CR604	48-2392B03	silicon
CR605 thru 607	48-82392B18	silicon
CR609	48-82466H18	silicon
CR610	48-82392B03	silicon
		integrated circuit: (see note)
IC601	51-84320A02	M2002
IC602	51-34320A13	M2013
		transistor: (see note)
Q601	48-869641	PNP; M9641
Q602	48-860570	NPN; M9570
		resistor, fixed: ± 5%; 1/4 W; unless otherwise stated
R601	6-124C15	39 ± 10%
R602	6-124A45	680
R603	6-124C49	1k ± 10%
R604	6-124A75	12k
R605	6-124A83	27k
R606	6-124C23	10k ± 10%
R607	18-83083G20	variable; 50k ± 30%
R608	6-124A75	12k
R609	18-83-83G14	variable; 1k ± 30%
R610	6-124C83	27k ± 10%
R611	6-124A39	390
R612	6-124A45	680
R613	6-124C89	47k ± 10%
R614	6-124C83	27k ± 10%
R615	6-124C77	15k ± 10%
R616	6-124A61	3.3k
R617	6-124A69	6.8k
R618	6-124A74	11k
R619	6-124A89	47k
R620	6-124A83	27k
R621	6-124C25	100 ± 10%
R622	6-124D08	270k ± 10%
R623	6-124A71	8.2k
		non-referenced items
	3-134169	SCREW, tapping: 4-40 × 1/4"
	3-129506	SCREW, tapping: 4-40 × 5/16"; 4 req'd.
	5-84220B01	GROMMET
	9-84207B01	CONNECTOR, 7-contact
	42-84284B01	RETAINER, screw; 4 req'd.
	55-84300B02	HANDLE; 1.83" lg.
	55-84973E01	HANDLE; 1.40" lg.
	76-84069B01	FERRITE BEAD; 3 req'd.
	1-80785B27	CIRCUIT BOARD ASSEMBLY includes:
	29-84028H01	TERMINAL, male; 9 req'd.
	5-84500B03	EYELET, special; 4 req'd.

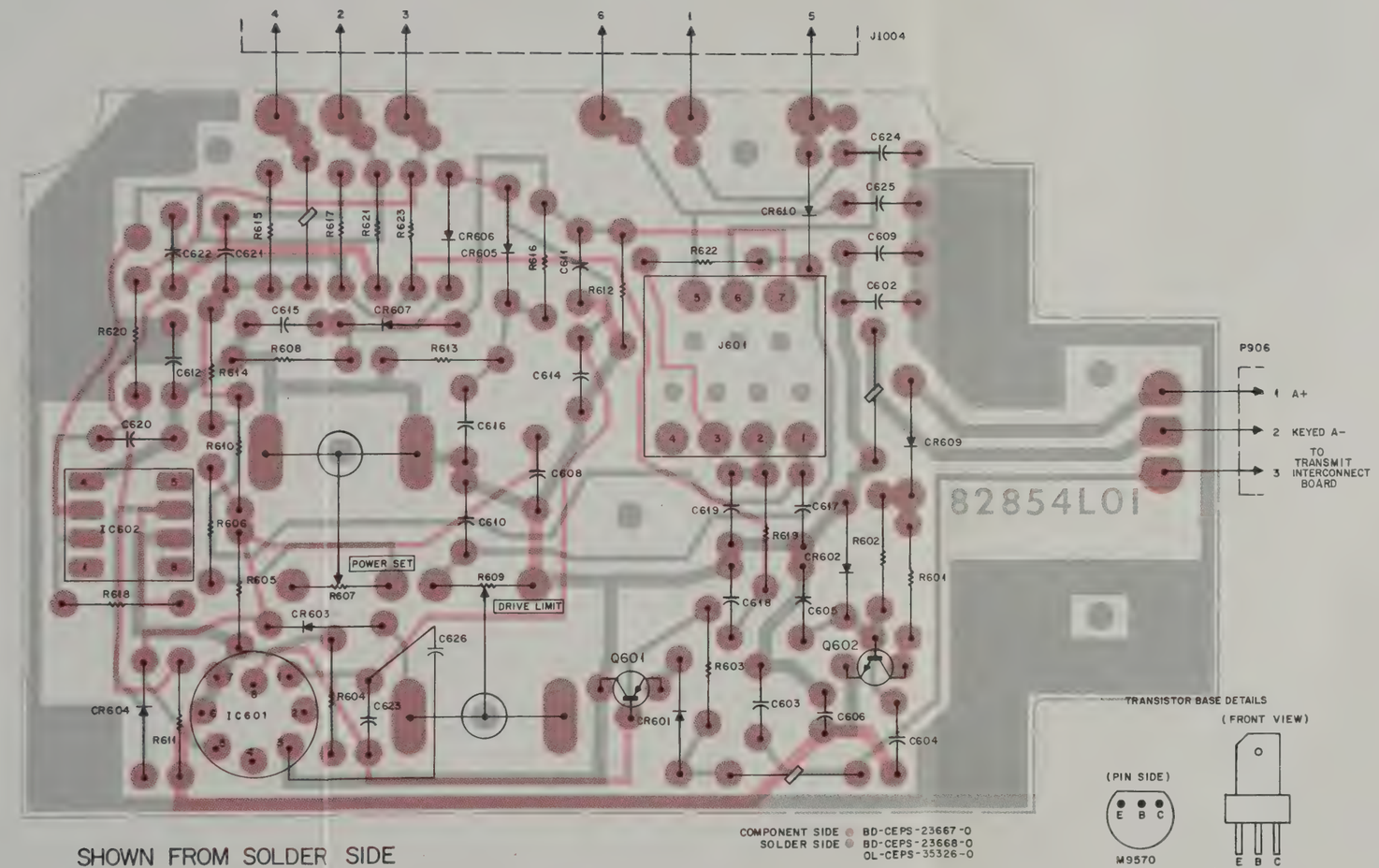
te: For optimum performance, diodes, transistors, and integrated circuits must ordered by Motorola part numbers.

TRN4845A Power Control Board
Schematic Diagram, Circuit Board Detail,
and Parts List
(Sheet 1 of 2)
Motorola No. ***PEPS-35506-O***
12/1/82- UP



TRN4845A Power Control Board
Schematic Diagram, Circuit Board Detail
and Parts List
(Sheet 2 of 2)
Motorola No. ***PEPS-35506-O***
12/1/82- UP

POWER CONTROL BOARD



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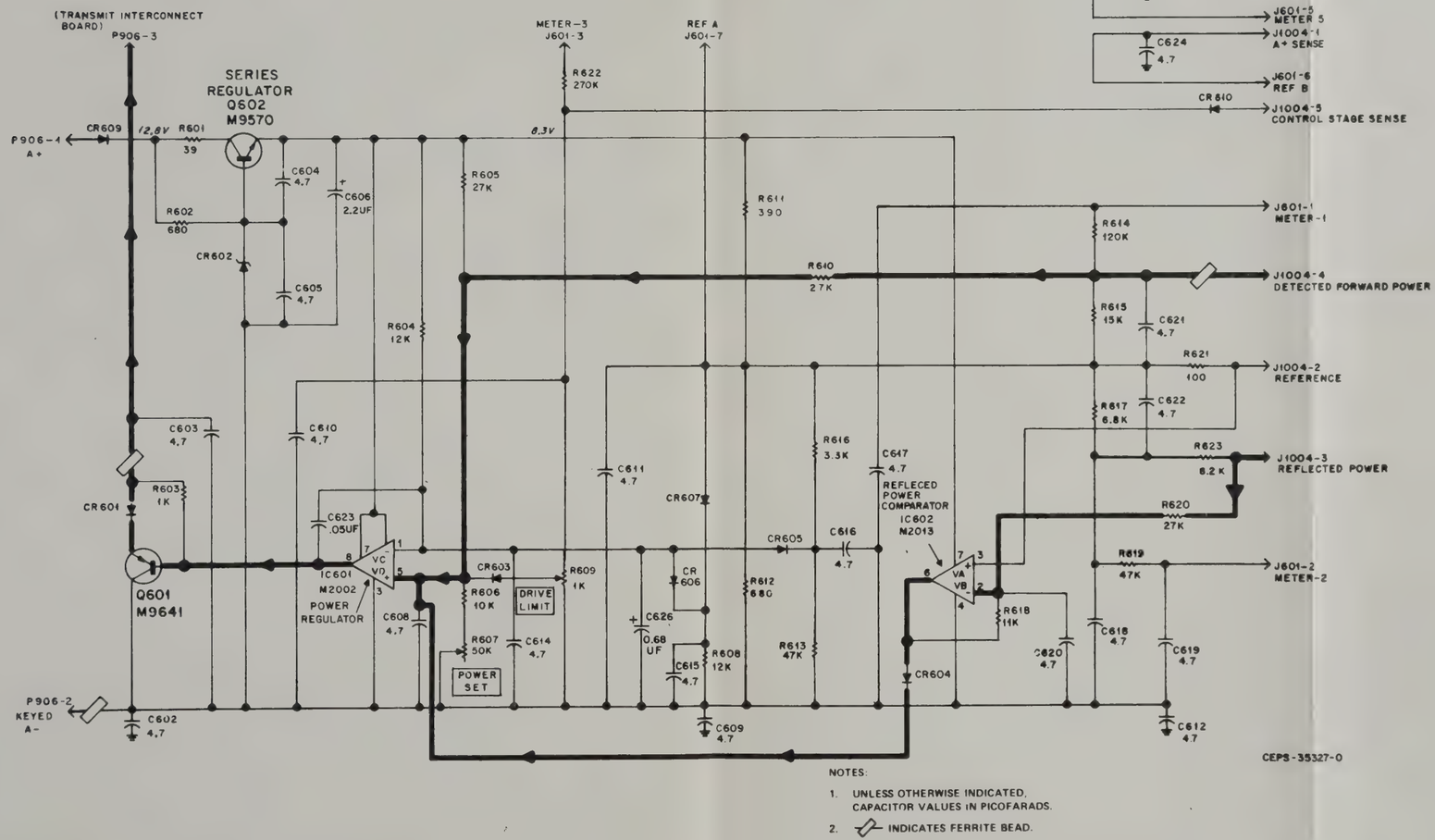
parts list

TRN4845A Power Control Board — PL-8195-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C602 thru 605	21-82355B39	4.7 pF; 0.25 pF; 500 V
C606	23-84538G08	2.2 uF ± 20%; 20 V
C608 thru 622	21-82355B39	4.7 pF; 0.25 pF; 500 V
C623	21-82372C07	.05 uF + 80-20%; 25 V
C624, 625	21-82355B39	4.7 pF; 0.25 pF; 500 V
C626	23-82783B48	0.68 uF ± 10%
		diode: (see note)
CR601	48-83654H01	silicon
CR602	48-83696E04	silicon
CR603	48-4616A01	hot carrier
CR604	48-2392B03	silicon
CR605 thru 607	48-82392B18	silicon
CR609	48-82466H18	silicon
CR610	48-82392B03	silicon
		integrated circuit: (see note)
IC601	51-84320A02	M2002
IC602	51-34320A13	M2013
		transistor: (see note)
Q601	48-869641	PNP; M9641
Q602	48-860570	NPN; M9570
		resistor, fixed: ± 5%; 1/4 W; unless otherwise stated
R601	6-124C15	39 ± 10%
R602	6-124A45	680
R603	6-124C49	1k ± 10%
R604	6-124A75	12k
R605	6-124A83	27k
R606	6-124C23	10k ± 10%
R607	18-83083G20	variable; 50k ± 30%
R608	6-124A75	12k
R609	18-83-83G14	variable; 1k ± 30%
R610	6-124C83	27k ± 10%
R611	6-124A39	390
R612	6-124A45	680
R613	6-124C89	47k ± 10%
R614	6-124C83	27k ± 10%
R615	6-124C77	15k ± 10%
R616	6-124A61	3.3k
R617	6-124A69	6.8k
R618	6-124A74	11k
R619	6-124A89	47k
R620	6-124A83	27k
R621	6-124C25	100 ± 10%
R622	6-124D08	270k ± 10%
R623	6-124A71	8.2k
		non-referenced items
	3-134189	SCREW, tapping: 4-40 × 1/4"
	3-129506	SCREW, tapping: 4-40 × 5/16"; 4 req'd.
	5-84220B01	GROMMET
	9-84207B01	CONNECTOR, 7-contact
	42-84284B01	RETAINER, screw; 4 req'd.
	55-84300B02	HANDLE; 1.83" lg.
	55-84973E01	HANDLE; 1.40" lg.
	76-84069B01	FERRITE BEAD; 3 req'd.
	1-80785B27	CIRCUIT BOARD ASSEMBLY includes:
	29-84028H01	TERMINAL, male; 9 req'd.
	5-84500B03	EYELET, special; 4 req'd.

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN4845A Power Control Board
Schematic Diagram, Circuit Board Detail, and Parts List
(Sheet 1 of 2)
Motorola No. ***PEPS-35506-O***
12/1/82- UP



NOTES:

1. UNLESS OTHERWISE INDICATED, CAPACITOR VALUES IN PICOFARADS.
2. INDICATES FERRITE BEAD.

TRN4845A Power Control Board
Schematic Diagram, Circuit Board Detail and Parts List
(Sheet 2 of 2)
*Motorola No. **PEPS-35506-O***
12/1/82-UP

MOTOROLA INC.
Communications Sector

FINAL POWER AMPLIFIER
MODEL TLF1222A
BLOWER AND SHROUD
MODEL TRN6729A

TLF1222A
Final PA Model Complement

Model	Description
TKN6835A	Cable Kit
TLF6472A	Amplifier Cavity
TRN4850A	Chassis and Hardware Kit
TRN6588A	Control Logic Board

1. FUNCTIONAL OPERATION

The output from the directional coupler is applied to the final power amplifier input coupling. The rf carrier is applied to an EIMAC 3CX400U7/8961 UHF Transmitting Triode designed primarily for the 928 to 960 MHz frequency spectrum. In the supplied grounded grid, cathode driven configuration, the tube provides 125 W of final rf output power. The carrier is coupled through a low pass harmonic filter to the antenna.

2. ALIGNMENT PROCEDURE

WARNING
High voltages are present when power is applied to the station. Under no circumstances should the station be operated with any of the power amplifier cavity screws loose. The adjustable wall screws must all be tightened before applying power to the station. Attempting to tune the adjustable walls with power applied is both improper and dangerous.

2.1 PRELIMINARY ADJUSTMENT

Step 1. Insure that no ac power is applied to the station.

Step 2. Before attempting to align the power amplifier, insure that the exciter, IPA, and low voltage power supply adjustments have been made.

Step 3. Connect a 250 watt wattmeter between the antenna output connector and the antenna.

Step 4. Loosen locking screws on the output coupling, output fine tuning, input coupling, and input fine tuning controls.

Step 5. Set the controls on amplifier as indicated below. (See Figure 1.)

- OUTPUT TUNING CONTROL — Fully ccw (as looking down on the cavity) or control knob fully extended out.
- PLATE CURRENT CONTROL — Fully ccw.
- OUTPUT COUPLING CONTROL — Fully ccw (as looking down on cavity) or control knob fully in.

Step 6. Tighten down *all* screws on power amplifier cavity, front and rear. This step is important to insure proper operation of the cavity.

2.2 TUNING PROCEDURE

After making preliminary adjustments, perform the following tuning procedure.

Step 1. Apply power to the station. After the transmitter is enabled by the transmit inhibit circuitry (see section 68P81031E53) in the Power Supplies section, key the station. Slide the coarse input coupling control in and out. Observe the best dip on power control Meter 2 reading.

NOTE
The dip can be very sharp, so move the control very slowly in small amounts.

Step 2. Alternately turn the input coupling and input tuning controls for minimum reflected power (power control Meter 2).

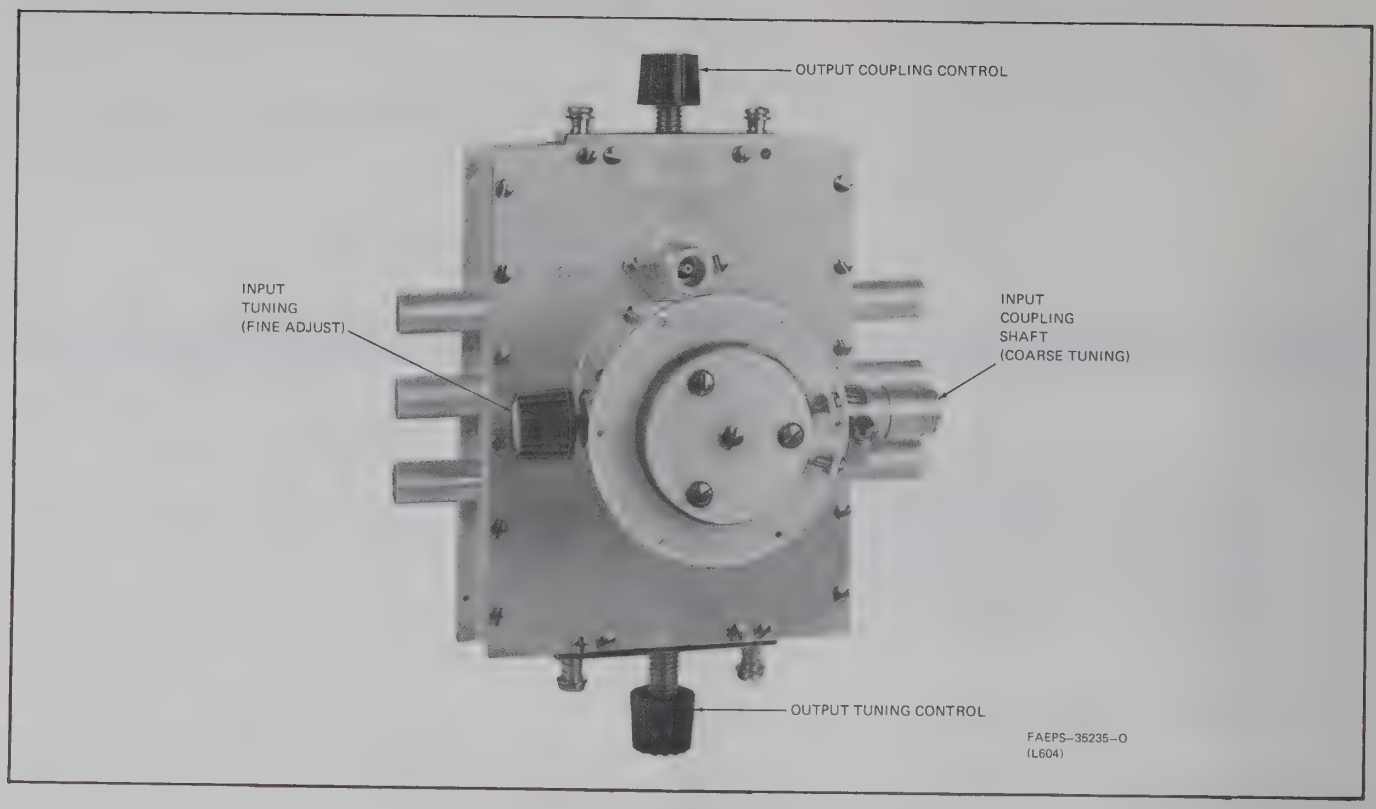


Figure 1. Final Power Amplifier Controls

Step 3. Alternately turn the output coupling and output tuning controls for maximum power output.

Step 4. Increase the plate current adjustment control to achieve approximately 300 mA or 125 W rf output, whichever comes first.

Step 5. Adjust the input tuning and input coupling controls to minimum power control Meter 2 reading.

Step 6. Adjust output tuning and output coupling controls for maximum power output. Continue adjustments until no further improvement can be obtained.

Step 7. Adjust the plate current control to achieve 125 W rf output from the station.

Step 8. Tighten down the output coupling and tuning controls and then the input coupling shaft and tuning control.

3. MAINTENANCE AND TROUBLESHOOTING

3.1 PERFORMANCE CHECKS

The power amplifier should be periodically checked for proper operation. Refer to Table 1 for typical PA check points and normal readings.

3.2 TROUBLESHOOTING

If the above performance tests indicate a PA malfunction, refer to the appropriate step in the following troubleshooting procedure.

Step 1. Apply power to the station. Measure the filament voltage. If voltage is below 6.3 volts, adjust the filament voltage (see section 68P81031E53, paragraph 4). If the voltage is zero, check the filament regulator board on the low voltage power supply.

Step 2. Measure the plate voltage. If less than 1500 V dc, check the high voltage power supply (section 68P81031E52).

Table 1. Typical Final PA Meter Readings

Test Point	Meter Reading	
	Keyed	Unkeyed
Filament Voltage	4.8 V dc	6.3 V dc
Plate Voltage	1500 V dc	1500 V dc
PA Current	300 mA	—
Reflected Power	—	—
Power Output	60-125 Watts Variable	—

Step 3. Key the station and measure the output power. If power is low, perform Steps 4 through 7. If power is zero, perform Steps 8 through 9.

Step 4. Measure the filament voltage. If a value other than 4.8 V dc is obtained, adjust the filament voltage (see section 68P81031E53, paragraph 4).

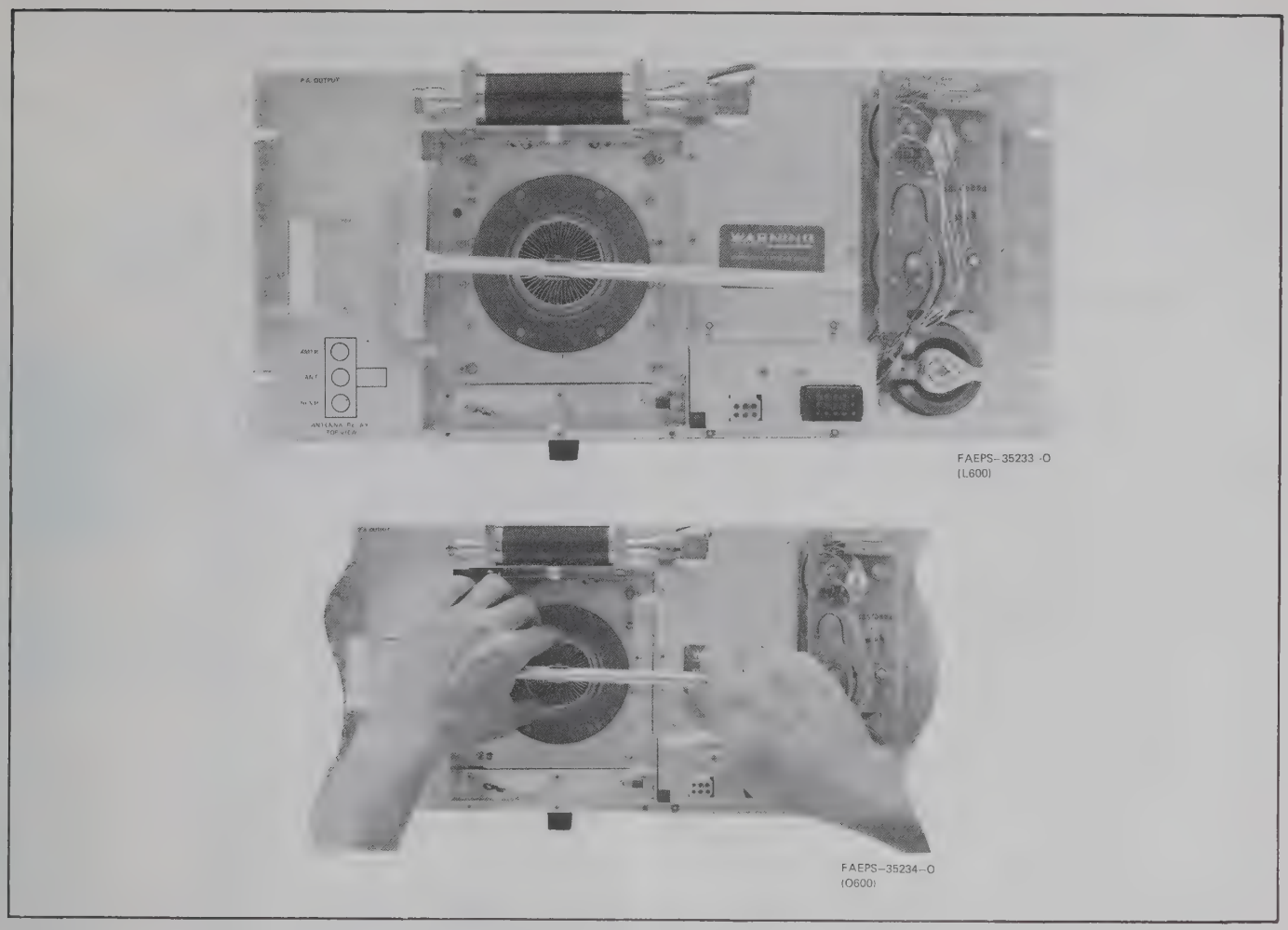


Figure 2. PA Tube Pulling Procedure

Step 5. Measure the plate current. If low or high, adjust R900 to obtain a normal reading and retune the output coupling and tuning. If the plate current is zero, check the high voltage power supply (section 68P81031E52).

Step 6. Measure the power output. If output is low, retune the entire PA (see paragraph 3.2).

Step 7. If power output is still low, replace the PA tube (see paragraph 3.3).

Step 8. Measure the filament voltage. If other than 4.7 V dc, check the filament regulator board.

Step 9. Measure the plate current. If low, remove the cover to the TRN6588A Control Logic Board. Measure the collector voltage at Q900 (25 V dc unkeyed, 0 V dc keyed). If abnormal readings are obtained, check the biasing circuitry. If the biasing is functioning properly, replace Q900.

3.3 TUBE REPLACEMENT PROCEDURE

Step 1. Remove blower cover.

Step 2. Remove plate cap.

Step 3. Remove circular plastic anode clamp ring (item #24).

Step 4. Position the tube puller, with the lifting fingers under the top cap of the tube. It is essential that the puller remain parallel to the surface of the cavity during tube removal. This allows the puller to exert force correctly and avoid damaging (bending) the tube anode cap.

Step 5. With the tube puller in place, pull slowly on the handle while guiding the tube as necessary. Note that the anode collet (item #29) will still be on the tube anode collet as it comes free of the cavity. After the tube is completely in the clear, *carefully* remove the anode collet from the tube by sliding it in the stem-to-cap direction. *Be sure* the collet is not cocked during this removal step. With the tube removed, the internal tube contact collets should be visually inspected. If the rings or finger stock are bent, replacement may be required. If any contact fingers are missing, replacement of that assembly is recommended as tuning will be effected.

Step 6. Install the insulator anode dielectric (item #25), the anode collet (item #29), and the circular plastic anode clamp ring (item #24) but *allow to remain loose so the anode collet can "float"*. Visually align the tube with the socket and insert it carefully, using straight-in pressure. With the tube seated, tighten the six screws on the circular plastic anode clamp ring (item #24).

Step 7. Perform the entire tune-up procedure.

4. TRN6729A BLOWER AND SHROUD

4.1 GENERAL

The blower and shroud provides cooling for the PA tube and vents the heated air outside the cabinet. The assembly does not provide cooling for other cabinet components.

4.2 BLOWER FILTER CLEANING PROCEDURE

To insure proper operation, the filters for the PA blower must be cleaned once every six months.

Step 1. Remove filters from blower assembly.

Step 2. Clean filters either by rinsing in warm water or thoroughly vacuuming them.

Step 3. Allow filters to completely dry and replace them.

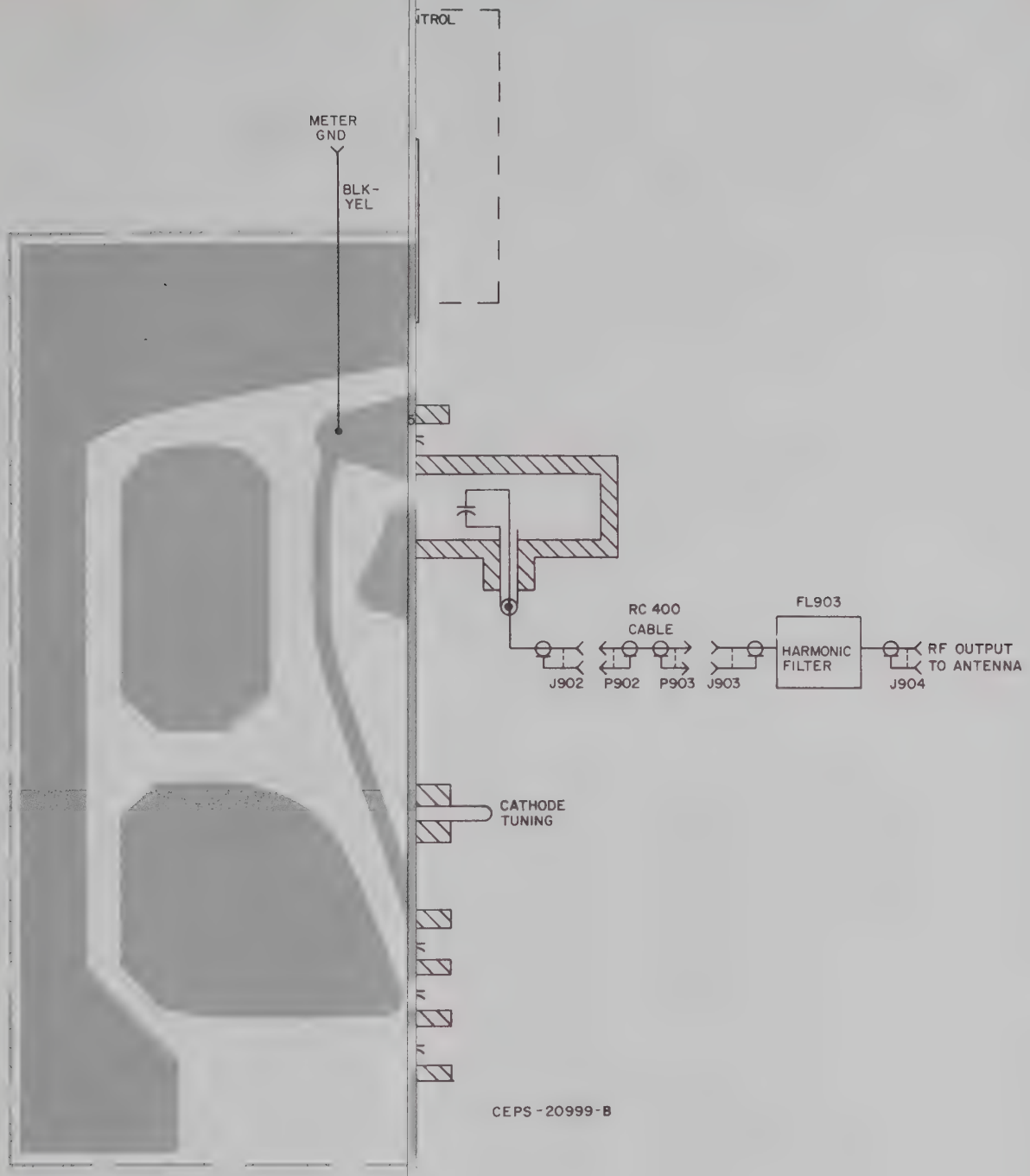
NOTE

The station can remain in operation during filter cleaning. In dusty environments, they should be cleaned more frequently (see table below).

Type of Environment	Frequency of Cleaning Filters
Heavy industrial or very dusty outdoor	Each Month
Outdoor (Average Dust)	3 Months
Average Industrial (Indoor)	6 Months
Average Residental (Indoor)	6 Months

4.3 BLOWER MAINTENANCE

The blower normally does not require maintenance. The blower motor contains lifetime lubricated, sealed bearings.



PARTS LISTS SHOWN ON BACK OF THIS DIAGRAM

TLF1222A Final Power Amplifier
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-35507-O
12/1/82- UP

Step 6. Install the insulator anode dielectric (item #25), the anode collet (item #29), and the circular plastic anode clamp ring (item #24) but *allow to remain loose so the anode collet can "float".* Visually align the tube with the socket and insert it carefully, using straight-in pressure. With the tube seated, tighten the six screws on the circular plastic anode clamp ring (item #24).

Step 7. Perform the entire tune-up procedure.

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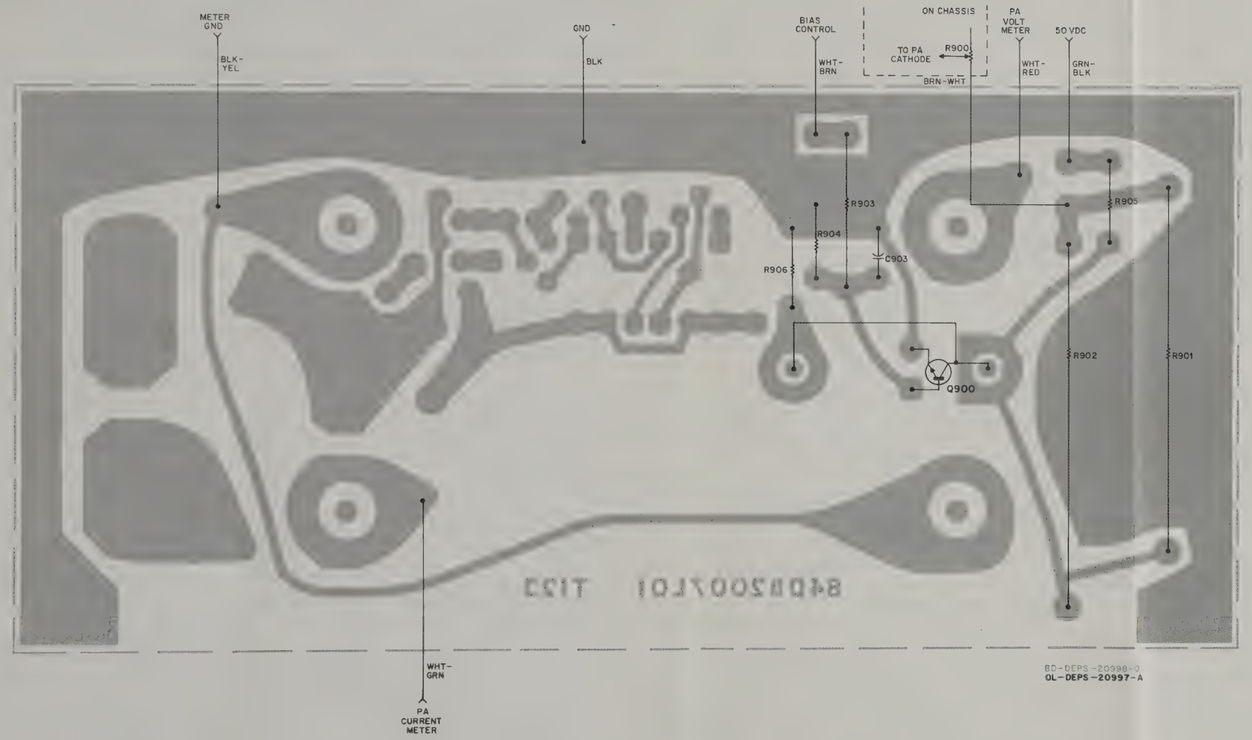
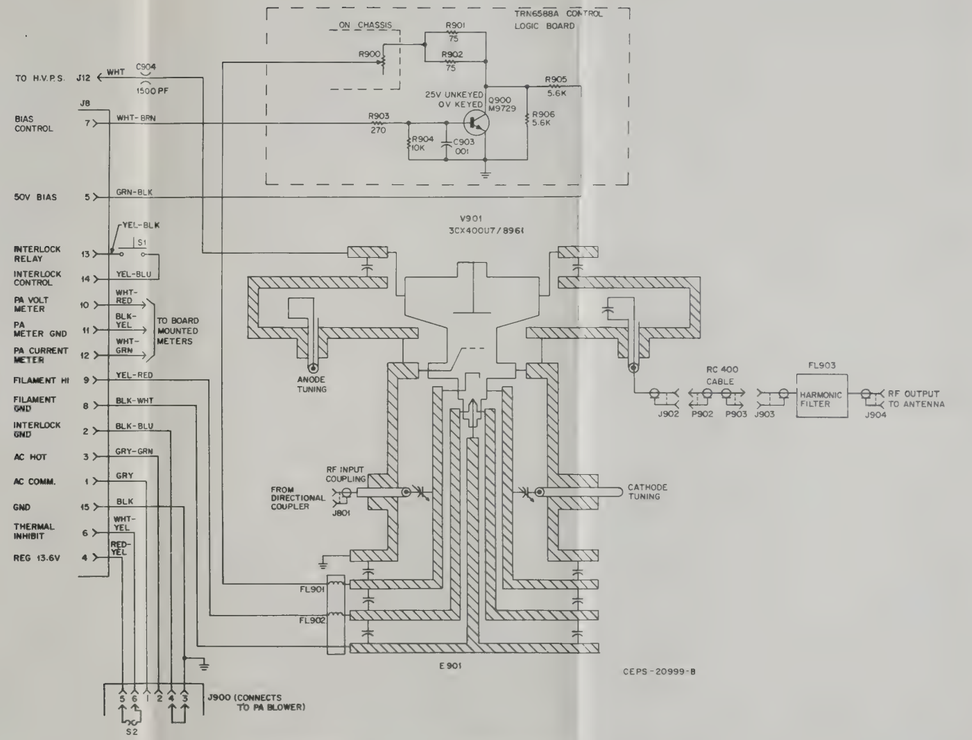




Model Table

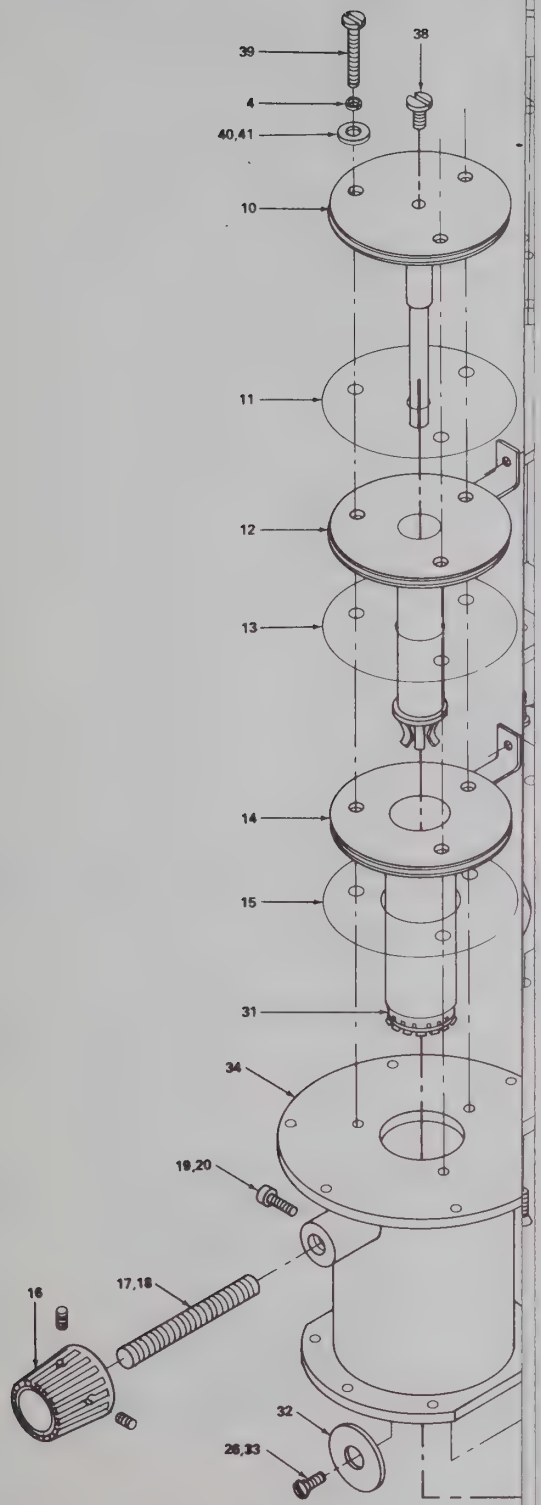
Model	Sub-Model	Suffix	Description
TLF1222A	TKN6835A		Transmitter Cable
	TLF6472A		Amplifier Cavity
	TRN4850A		Chassis & Hardware Kit
	TRN6588A		Control Logic Board
TRN6729A			Blower Kit
TRN6572A			Antenna Relay Kit

PARTS LISTS SHOWN ON BACK OF THIS DIAGRAM

TLF1222A Final Power Amplifier
Schematic Diagram and Circuit Board Detail
Motorola No. ***PEPS-35507-O***
12/1/82- UP

TLF1222A Final Power Amplifier Mechanical Parts List PL-8313-O

ITEM	MOTOROLA PART NO.	DESCRIPTION
1	1-82479N01	TUNING ASSY.-R.H.
2	54-82479N02	LABEL, tuning
3	—	SCREW, machine: 4-40 × 5/16"; 28 used
4	4-8442	LOCKWASHER, #4 split; 45 used
5	1-82479N03	SIDE BAR ASSY.; 2 used
6	54-82479N04	LABEL, output
7	3-1237	SCREW, machine: 4-40 × 1/4"; 12 used
8	1-82479N04	OUTPUT CONNECTOR ASSY.
9	1-82479N05	TUNING ASSY.-L.H.
10	39-82479N06	CONTACT ASSY., heater
11	14-82479N07	INSULATOR, inner heater (dielectric)
12	39-82479N08	CONTACT ASSY., outer heater
13	14-82479N09	INSULATOR, outer heater (dielectric)
14	38-82479N10	CONTACT ASSY., cathode collet
15	14-82479N11	INSULATOR, cathode (dielectric)
16	36-82479N12	KNOB, control
17	3-82479N13	SCREW, probe
18	11-82479N14	LUBRIPLATE (930 AA), as required
19	3-1587	SCREW, machine: 6-32 × 5/16"
20	4-82418B03	WASHER, insulating; 1/12 used
21	64-82479N15	GRID PANEL ASSY.
22	64-82479N16	PANEL, anode
23	3-1534	SCREW, machine: 4-40 × 7/16"; 6 used
24	42-872479N17	CLAMP, ring-anode
25	14-82479N18	INSULATOR, anode (dielectric)
26	3-1938	SCREW, machine: 4-40 × 1/4"; 6 used
27	1-82479N19	GRID COLLET ASSY.
28	14-82479N20	WASHER, insulating
29	1-82479N21	ANODE COLLET ASSY.
30	54-82479N22	LABEL, high voltage
31	42-82479N23	SPRING, cathode collet
32	49-82479N24	DISK, probe; 2 used
33	11-82479N25	LOCTITE, grade CV; as required
34	15-82479N26	HOUSING ASSY.
35	58-82479N27	SLIDING PROBE ASSY.
36	42-82479N28	CLAMP, hose
37	54-82479N29	LABEL, coupling
38	3-8031	SCREW, machine: 6-32 × 1/4"; 3 used
39	3-1413	SCREW, machine: 4-40 × 5/8"; 3 used
40	4-114057	WASHER, flat: #4; 3 used
41	14-82479N30	INSULATOR, screen; 9 used
42	54-82479N31	LABEL, logo
43	3-7342	SCREW, machine: 6-32 × 3/8"; 4 used
44	11-82479N32	TAPE, kapton: 13/16" long
45	97-10794A01	TUBE, transmitting



TLF1222A Final Power Amplifier
Parts Location Detail
Motorola No. ***PEPS-35613-O***
12/1/82 UP

parts list

TKN6835A Cable Transmitter (125 Watt) — PL-4378-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J8		**connector, receptacle:** includes:
	14-82834H03	INSULATOR, 15-circuit
	29-82335A01	CONTACT, male; 15 req'd.
J900		includes:
	15-10183A57	INSULATOR, 6-circuit
	29-82336A01	CONTACT, female; 6 req'd.
		mechanical parts
	29-8383C06	LUG, solderless; 2 req'd.
	42-10217A02	STRAP, cable harness

TRN4850A Chassis and Hardware Kit — PL-8208-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C904	21-83289A03	**capacitor, fixed:** 1500 uF + 100-0%; 2500 V
FL901, 902	91-87511C01	**filter:** RFI
FL901	91-84013K02	low-pass
J12	30-82904H01	**connector & cable assy.:** single contact
P902	28-852527	**connector, plug:** male; single contact
P903	28-82398E02	male; single contact
R900	18-82779L01	**resistor, variable:** W.W. 300; 50 W
S1	40-82293F01	**switch, snap:** spst
		mechanical parts
	2-131435	NUT, 4-40 × 1/4 × 3/32"; 11 req'd.
	3-1437	SCREW, machine; 4-40 × 5/8"; 2 req'd.
	3-139012	SCREW, machine; 4-40 × 1/4"; 8 req'd.
	3-134186	SCREW, tapping; 6-32 × 5/16"; 8 req'd.
	3-135111	SCREW, tapping; 4-40 × 3/8"; 13 req'd.
	3-138182	SCREW, tapping; 4-40 × 3/8"; 6 used
	4-7670	LOCKWASHER, 1/4" internal; 4 used
	5-483208	GROMMET; 8 req'd.
	7-82040L01	FRAME, filter; 2 req'd.
	7-82075L01	BRACKET, connector mounting
	14-82311L01	INSULATOR, switch
	15-82038L01	HOUSING, filter; 2 req'd.
	15-82039L01	COVER, meter
	28-817985	CONNECTOR ADAPTER, right angle
	29-5293	LUG, soldering #4L
	29-824456	LUG, tongue
	35-82310L01	SCREEN, air; 2 req'd.
	36-82632H07	KNOB, control
	42-84284B01	RETAINER; 6 used
	42-10217A02	STRAP, cable harness
	42-82041L01	CLIP, filter mounting; 2 req'd.
	42-82143C02	CLAMP, cable
	43-82350N01	SPACER, box
	43-82351N01	SPACER; 4 used
	72-84865B06	METER
	72-84865B07	METER
	64-82306L01	PLATE, PA; mounting
	7-82074L01	MOUNTING, fan
	3-1819	SCREW, machine; 6-32 × 3/16"
	54-84119B01	LABEL WARNING
	75-82471N01	BUMPER NEO.; 4 used
	1-80708D74	HOUSING, PA terminal incl. ref. part FL901, 902
	15-82302L01	HOUSING, PA
	1-80706D75	COVER, PA terminal
	15-82355H01	CAP, tube (V901)
	15-82307L01	COVER, PA
	3-138162	SCREW, tapping; 4-40 × 3/8"
	3-82227A01	SCREW, special; 6 req'd.
	3-134293	SETSCREW; 10-32 × 1/4"
	30-84173E01	CABLE, coaxial: double-shielded; 11" req'd.

TRN6588A Control Logic Board — PL-4381-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C903	21-82187B20	**capacitor, fixed:** .001 uF ± 10%, 100 V
Q900	48-869729	**transistor: (see note)** NPN; type M9729
R901, 902	17-82177B29	**resistor, fixed:** 75 ± 10%; 7 W
R903	6-126C35	270 ± 10%; 1 W
R904	6-124A73	10k ± 5%; 1/4 W
R905, 906	6-124C67	5.8k ± 10%; 1/4 W
		mechanical parts
	2-7005	NUT, 6-32 × 1/4 × 3/32"; 2 req'd.
	3-7229	SCREW, machine; 6-32 × 3/8"; 2 req'd.
	4-852212	WASHER, insulator; 2 req'd.
	4-7650	WASHER, #6; 2 req'd.

TRN6729A Blower Kit — PL-4385-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
S2	40-82585L01	**switch:** rotary, momentary
		mechanical parts
	3-136138	SCREW, tapping; 6-32 × 3/8"; 5 req'd.
	3-138806	SCREW, machine; 8-32 × 5/16"; 8 req'd.
	15-10183A56	INSULATOR, connector; 6-circuit
	29-82335A01	CONTACT, male; 8 req'd.
	42-83123F01	RETAINER, 5 req'd.
	59-82076L01	MOTOR, blower
	43-82546L01	SPACER
	3-8022	SCREW, machine; 4-40 × 1/4"
	3-136523	SCREW, machine; 4-40 × 7/8"; 2 used
	4-7667	LOCKWASHER #4 external; 3 req'd.
	15-84504M01	SHROUD
	35-84502M01	AIR VANE
	42-84501M01	SPRING CLIP
	64-84503M01	PLATE, switch mount

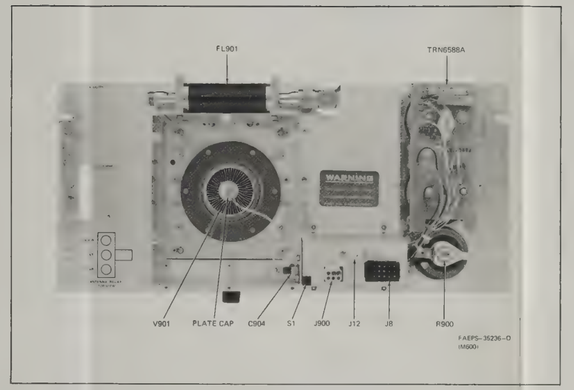
TLF6472A Amplifier Cavity — PL-8213-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
E901	1-82367N02	**cavity:** amplifier; assembly includes V901
V901	97-10794A01	**tube, electron:** 3CX400U7/8961

TRN6572A Antenna Relay Kit (Base Station Only) — PL-4434-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Field servicing of this unit is not recommended. Order entire unit for replacement.

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



PA Rear View Component Identification

TLF1222A Final Power Amplifier Mechanical Parts List — PL-8313-O

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1	1-82479N01	TUNING ASSY.:R.H.
2	54-82479N02	LABEL, tuning
3	—	SCREW, machine: 4-40 × 5/16"; 28 used
4	4-8442	LOCKWASHER, #4 split; 45 used
5	1-82479N03	SIDE BAR ASSY.; 2 used
6	54-82479N04	LABEL, output
7	3-1237	SCREW, machine: 4-40 × 1/4"; 12 used
8	1-82479N04	OUTPUT CONNECTOR ASSY
9	1-82479N05	TUNING ASSY.-L.H.
10	39-82479N06	CONTACT ASSY., heater
11	14-82479N07	INSULATOR, inner heater (dielectric)
12	39-82479N08	CONTACT ASSY., outer heater
13	14-82479N09	INSULATOR, outer heater (dielectric)
14	38-82479N10	CONTACT ASSY., cathode collet
15	14-82479N11	INSULATOR, cathode (dielectric)
16	36-82479N12	KNOB, control
17	3-82479N13	SCREW, probe
18	11-82479N14	LUBRIPLATE (930 AA), as required
19	3-1587	SCREW, machine: 6-32 × 5/16"
20	4-82418B03	WASHER, insulating; 1/12 used
21	64-82479N15	GRID PANEL ASSY.
22	64-82479N16	PANEL, anode
23	3-1534	SCREW, machine: 4-40 × 7/16"; 6 used
24	42-872479N17	CLAMP, ring-anode
25	14-82479N18	INSULATOR, anode (dielectric)
26	3-1938	SCREW, machine: 4-40 × 1/4"; 6 used
27	1-82479N19	GRID COLLET ASSY
28	14-82479N20	WASHER, insulating
29	1-82479N21	ANODE COLLET ASSY.
30	54-82479N22	LABEL, high voltage
31	42-82479N23	SPRING, cathode collet
32	49-82479N24	DISK, probe; 2 used
33	11-82479N25	LOCTITE, grade CV; as required
34	15-82479N26	HOUSING ASSY.
35	58-82479N27	SLIDING PROBE ASSY.
36	42-82479N28	CLAMP, hose
37	54-82479N29	LABEL, coupling
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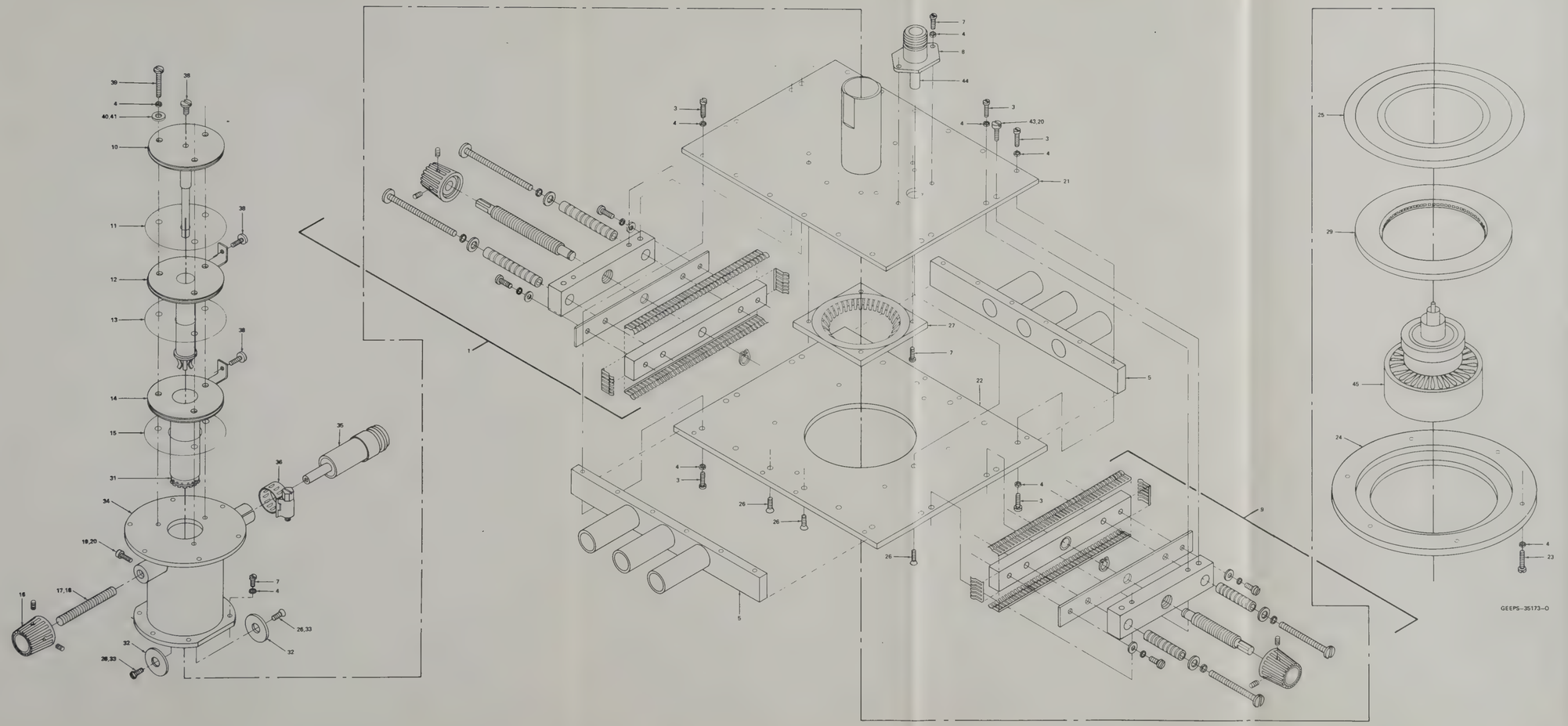
39	3-1413	SCREW, machine: 4-40 × 5/8"; 3 used
40	4-114057	WASHER, flat; #4; 3 used
41	14-82479N30	INSULATOR, screen; 9 used
42	54-82479N31	LABEL, logo
43	3-7342	SCREW, machine: 6-32 × 3/8"; 4 used
44	11-82479N32	TAPE, kapton: 13/16" long
45	97-10794A01	TUBE, transmitting



TLF1222A Final Power Amplifier
Parts Location Detail
Motorola No. PEPS-35613-O
12/1/82 UP

parts list

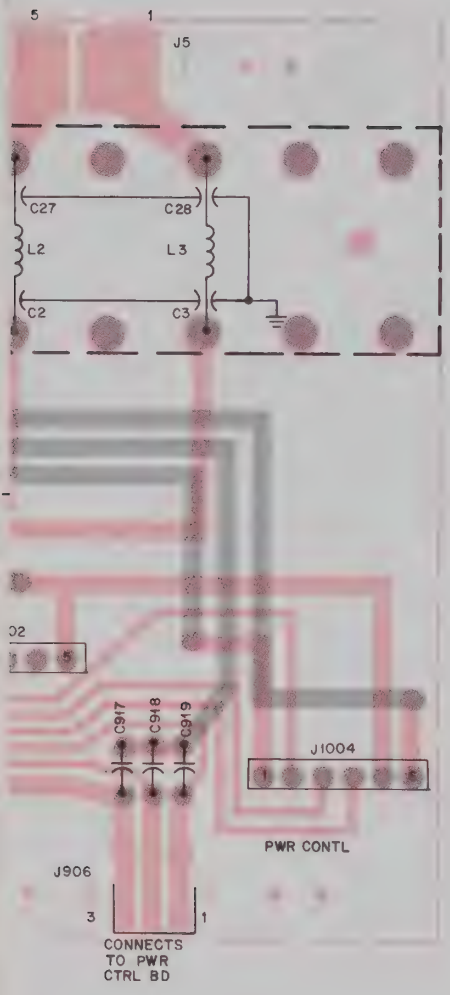
TRN5034A Transmitter Interconnect Board — PL-8212-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1 thru 18	21-861219	1000 pF + 100-0%; 500 V
C19	21-82812H01	100 pF ± 10%; 500 V
C20 thru 43	21-861219	1000 pF + 100-0%; 500 V
C44 thru 50	21-82812H01	100 pF ± 10%; 500 V
C901 thru 904	21-82372C02	0.2 uF + 80-20%; 25 V
C905, 906	21-82372C04	0.05 uF + 80-20%; 25 V
C907	23-83214C02	15 pF ± 20%; 20 V
C908	21-82372C04	0.05 uF + 80-20%; 25 V
C909	23-82783B31	47 pF ± 20%; 20 V
C910	21-82372C04	0.05 uF + 80-20%; 25 V
C911, 912		NOT USED
C913, 914	21-82204B06	100 pF ± 10%; N1500
C915, 916		NOT USED
C917, 918, 919	21-82187B07	470 pF ± 10%; 500 V
C920	23-83214C20	10 uF ± 20%; 20 V
C921, 922	21-82372C04	0.05 uF + 80-20%; 25 V
		diode: (see note)
CR901, 902	48-82392B12	silicon
CR903	48-82466H13	silicon
		connector, receptacle:
J1000	28-83441F07	male, 6 pin, WHT
J1001	28-83441F06	male, 6 pin, RED
J1002	28-83441F04	male, 5 pin, RED
J1003	28-83441F05	male, 5 pin, WHT
J1004	28-83441F07	male, 6 pin, WHT
		coil, rf:
L1 thru 6	24-83977B01	1-1/2 turns
L7 thru 12	24-83961B01	3 turns
L13, 14	24-83977B01	1-1/2 turns
L15	24-83961B01	3 turns
L16	24-83977B01	1-1/2 turns
L17, 18	24-83961B01	3 turns
L19, 20	24-83977B01	1-1/2 turns
L21	24-83961B01	3 turns
L22	24-83977B01	1-1/2 turns
L23, 24	24-83961B01	3 turns
L25	24-83977B01	1-1/2 turns
L901 thru 904	24-80900A61	choke 0.62 uH
L905, 906, 907	24-83961B01	3 turns
L909	24-83961B01	3 turns
L908	24-854314	choke 33 uH
L910, 911	24-82723H01	choke, 1.2 uH
		transistor: (see note)
Q901	48-869640	type M9640
Q902	48-869701	type M9701
		resistor, fixed: ± 10%; 1/4 W: unless otherwise stated
R901	6-124C97	100k
R902 thru 905	6-124C73	10k
R906	6-124C49	1k
R908	17-82291B21	100 ± 5%; 3 W
R910	6-124A03	12 ± 5%
R911	6-124C49	1k

non-referenced items

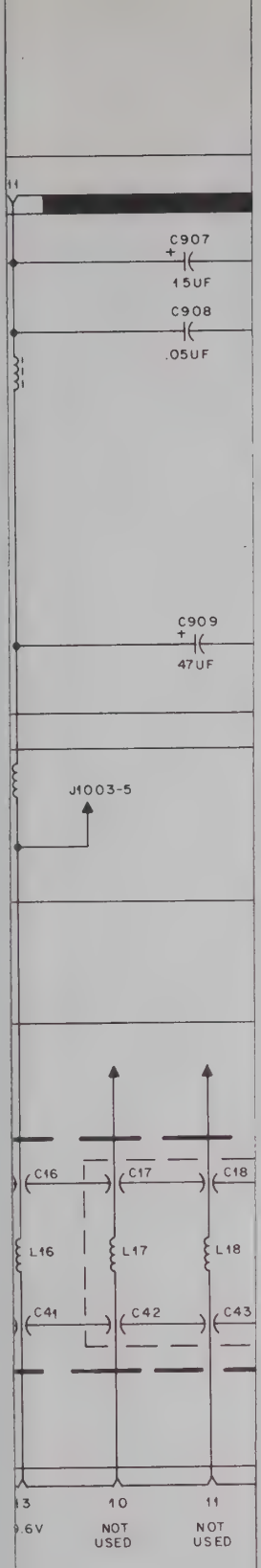
14-82621K01	INSULATOR
3-134169	SCREW, tapping: 4-40 x 1/4" Phillips, hex head
3-139495	SCREW, tapping: 4-40 x 5/16" Phillips; 4 used
5-84220B01	GROMMET
14-83375K01	INSULATOR
42-83629G01	FASTENER, driver; 2 used
1-80775B71	FILTER BRACKET ASSY.
1-80775B75	FILTER BRACKET COVER
14-82613M01	INSULATOR

note: Replacement diodes and transistors must be ordered by Motorola part number only for optimum perfomance.



TRANSMITTER INTERCONNECT BOARD

MODEL TRN5034A

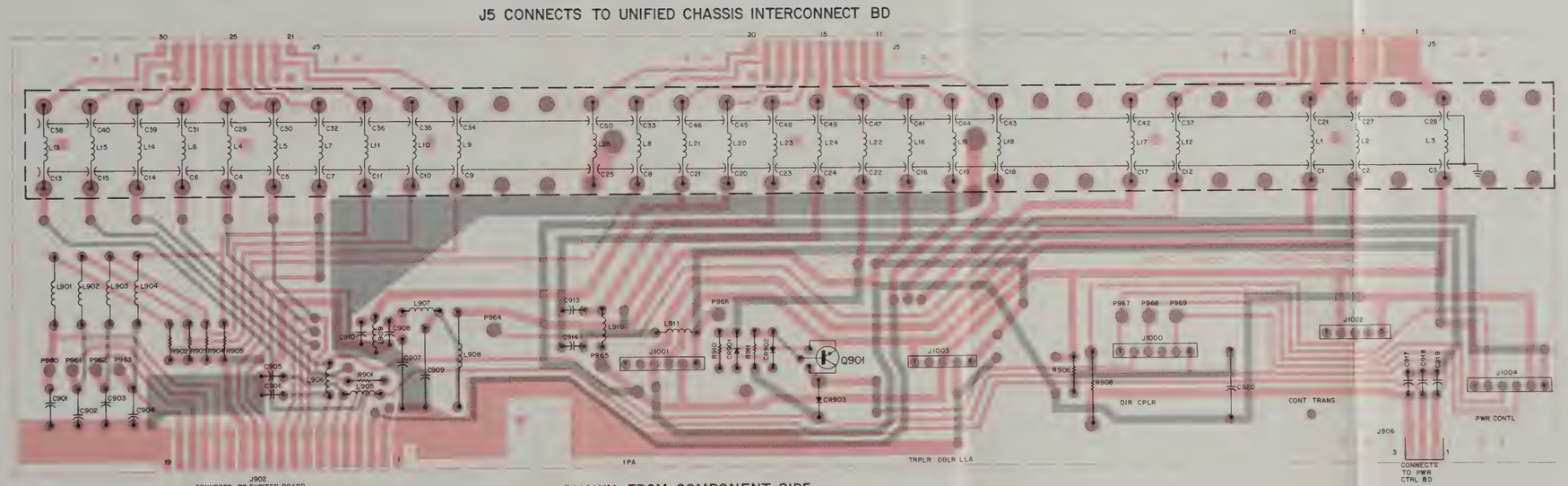


FUNCTION

- Interconnects most transmitter circuit boards to each other (except PA).
- Routes control functions from the unified chassis interconnect board to the transmitter.
- Includes partial control stage circuitry used to govern PA power output.
- Includes current limiter stage which is electrically functional with antenna network.

TRANSMITTER INTERCONNECT BOARD

MODEL TRN5034A



SHOWN FROM COMPONENT SIDE

SOLDER SIDE 80-EEPS-35360-O
COMPONENT SIDE 80-EEPS-35361-O
OL-EEPS-35362-O

parts list

TRN5034A Transmitter Interconnect Board — PL-6212-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1 thru 18	21-861219	1000 pF + 100-0%; 500 V
C19	21-82812H01	100 pF ± 10%; 500 V
C20 thru 43	21-861219	1000 pF + 100-0%; 500 V
C44 thru 50	21-82812H01	100 pF ± 10%; 500 V
C901 thru 904	21-82372C02	0.2 uF + 80-20%; 25 V
C905, 906	21-82372C04	0.05 uF + 80-20%; 25 V
C907	23-83214C02	15 pF ± 20%; 20 V
C908	21-82372C04	0.05 uF + 80-20%; 25 V
C909	23-82783B31	47 pF ± 20%; 20 V
C910	21-82372C04	0.05 uF + 80-20%; 25 V
C911, 912		NOT USED
C913, 914	21-82204B06	100 pF ± 10%; N1500
C915, 916		NOT USED
C917, 918, 919	21-82187B07	470 pF ± 10%; 500 V
C920	23-83214C20	10 uF ± 20%; 20 V
C921, 922	21-82372C04	0.05 uF + 80-20%; 25 V
		diode: (see note)
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J1002	28-83441F04	male, 5 pin, RED
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J1004	28-83441F07	male, 6 pin, WHT
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L19, 20	24-83977B01	1-1/2 turns
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		transistor: (see note)
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		resistor, fixed: ± 10%; 1/4 W: unless otherwise stated
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R908	17-82291B21	100 ± 5%; 3 W
R910	6-124A03	12 ± 5%
R911	6-124C49	1k
		non-referenced items
	14-82621K01	INSULATOR
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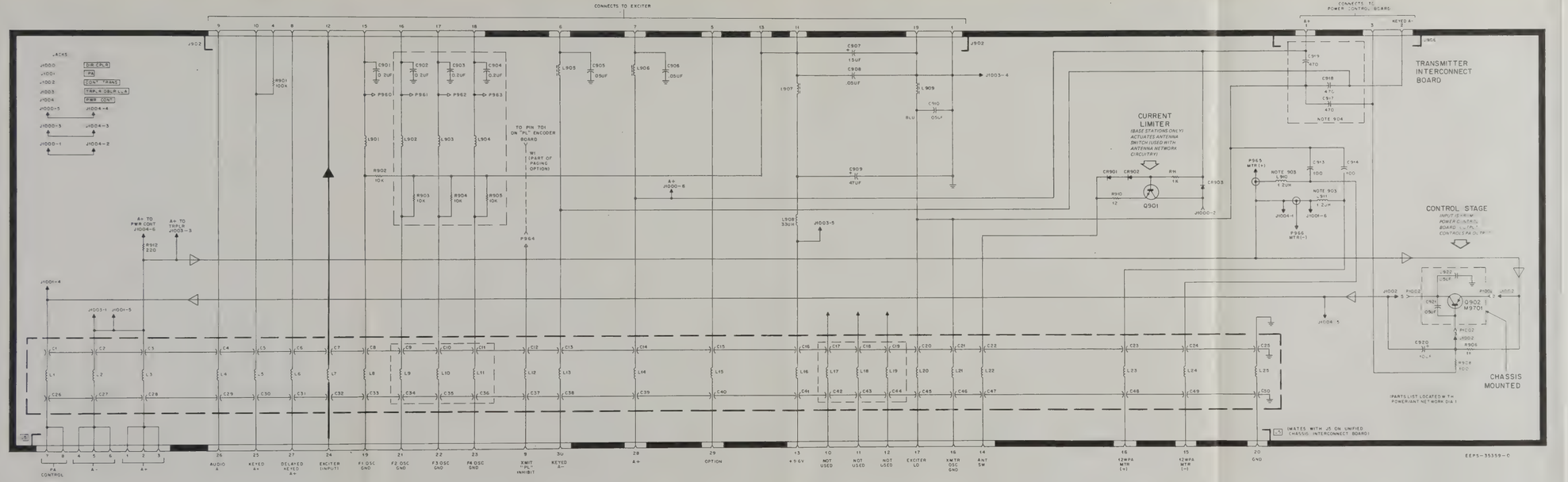
	3-139495	SCREW, tapping: 4-40 x 5/16" Phillips; 4 used
	5-84220B01	GROMMET
	14-83375K01	INSULATOR
	42-83629G01	FASTENER, driver; 2 used
	1-80775B71	FILTER BRACKET ASSY.
	1-80775B75	FILTER BRACKET COVER
	14-82613M01	INSULATOR

note: Replacement diodes and transistors must be ordered by Motorola part number only for optimum perfomance.

*Motorola No. **PEPS-35508-O***
(Sheet 1 of 2)
12/1/82- UP

TRANSMITTER INTERCONNECT BOARD

MODEL TRN5034A



NOTES

901 UNLESS OTHERWISE SPECIFIED CAPACITOR VALUES ARE IN PICOFARADS.

902 FILTERING CHOKES AND BYPASS CAPACITORS ARE USED ON VOLTAGE AND GROUND RUNS TO PREVENT RF RADIATION FROM BEING CONDUCTED TO THE UNIFIED CHASSIS INTERCONNECT BOARD AND AFFECTING STATION OPERATION.

903 FILTERING CHOKES L910 AND L911 (FUNCTIONAL WITH 12 WATT STATIONS ONLY) PROVIDE FILTERING FOR BUILT-IN STATION METERING.

904 CAPACITORS C917, C918 AND C919 SHUNT RF ENERGY ON THE A+ KEYED A- AND POWER CONTROL LEADS TO GROUND.

LEGEND

= THEORY OF OPERATION DATA

= PRIMARY SIGNAL FLOW

= SECONDARY SIGNAL FLOW

FUNCTION

- Interconnects most transmitter circuit boards to each other (except PA).
- Routes control functions from the unified chassis interconnect board to the transmitter.
- Includes partial control stage circuitry used to govern PA power output.
- Includes current limiter stage which is electrically functional with antenna network.

Motorola No. PEPS-35508-O
(Sheet 2 of 2)
12/1/82-UP

MICOR SENSITRON RECEIVER RF AND I-F BOARD

MODEL TRF1032A
900 MHz

1. INTRODUCTION

This section contains specific theory of operation, maintenance, and troubleshooting information on the receiver rf and i-f deck.

2. RECEIVER RF AND I-F DECK FUNCTIONAL DESCRIPTION

2.1 RF INJECTION STRING

2.1.1 Oscillator (Channel Element)

Channel elements are temperature compensated, crystal controlled oscillators (TCXO), operable over the temperature range of −30° to +60°C (−22° to +140°F). A variable warp capacitor, located in the base of the oscillator, is provided for increased accuracy. Channel elements are factory sealed plug-in modules and should not be field serviced.

2.1.2 Multipliers

The third harmonic of the channel element is selected by a two cell LC tuned circuit. The signal is then multiplied 16 times by two doubler circuits and a double doubler circuit and applied to the two cell preselector of the first mixer.

2.2 RF PRESELECTOR

RF preselector selectivity prevents receiver degradation from mixer image frequency and spurious harmonics. It consists of five low loss, highly selective helical resonant cavities. The bandpass of the preselector is characterized by a flat acceptance bandwidth and a steep skirt response. Carrier signals received at the antenna are routed through the preselector for cavities to the mixer stage to be heterodyned with the injection frequency.

2.3 FIRST MIXER

The first mixer heterodynes the rf signal from the injection string with the carrier signal from the preselector, producing a high i-f of 45 MHz. Frequency relationships are as follows:

$$f_c = 48f_o + 45\ \text{MHz}$$

Where: f_c = carrier frequency
f_o = channel element fundamental

2.4 DOUBLE-POLE CRYSTAL FILTER

The double-pole crystal filter accepts the high i-f of 45 MHz and attenuates signals outside the bandwidth. It increases receiver selectivity and couples the high i-f to the second mixer.

2.5 SECOND MIXER

The second mixer uses a field effect transistor with low noise level and high conversion gain to heterodyne the high i-f with a second oscillator frequency, producing a low i-f of 11.7 MHz. Frequency relationships are expressed as follows:

$$45\ \text{MHz} = f_o + 11.7\ \text{MHz}$$

Where f_o = second oscillator frequency

2.6 SECOND OSCILLATOR AND BUFFER

The second oscillator is a crystal controlled, tunable oscillator. It employs a buffer output to prevent load variations from degrading the generated signal and filtering to reduce spurious harmonics.

2.7 FIRST FOUR-POLE CRYSTAL FILTER

This filter and the second four-pole crystal filter are the major factors determining final receiver bandwidth and selectivity.

The first four-pole crystal filter consists of two monolithic crystals and associated impedance matching circuitry. The output of the mixer is coupled to the input of the filter by an adjustable matching network.

Each crystal produces mechanical vibrations at the crystal input when the electrical i-f signal is applied. Due to the inherent piezoelectric property of quartz crystals, these vibrations are propagated throughout the crystal and reconverted to electrical signals at the output electrodes. The high "Q" of the crystals creates a narrow bandpass resulting in excellent off-channel signal rejection.

2.8 FIRST I-F AMPLIFIER

The first i-f amplifier couples signals between the first and second four-pole crystal filters and provides approximately 70 dB gain. The integrated circuit (U601) contains three differential amplifier stages that are internally voltage regulated and temperature compensated. Isolation between the three stages is provided internally.

2.9 SECOND FOUR-POLE CRYSTAL FILTER

The second four-pole crystal filter establishes final receiver selectivity and operates identically to the first four-pole crystal filter previously described. The filter signal is applied to the second i-f amplifier.

2.10 SECOND I-F AMPLIFIER AND LIMITER

The second i-f amplifier and limiter consists of integrated circuit (U602) and with associated discrete components performs amplification and limiting functions.

Four differential amplifiers with internal voltage regulation and temperature compensation are employed. The first two differential amplifiers provide approximately 55 dB gain. The second stage output provides metering and is applied to the third stage. The third stage, along with the fourth stage, becomes overdriven to provide excellent symmetrical limiting characteristics. Full limiting occurs regardless of signal strength.

The limited output of the second i-f amplifier is applied to the discriminator. Since amplitude has now been made constant, the discriminator, which normally would respond to both amplitude and frequency variations produces true frequency demodulation.

3. MAINTENANCE

3.1 INTRODUCTION

This section provides maintenance procedures for the receiver rf and i-f board. These procedures consist of tests which include metering measurements and testing and troubleshooting procedures that includes integrated circuit checks.

NOTE

The receiver rf and i-f board must be installed in a receiver chassis for testing to provide the necessary power, ground, control and signal connections. The board should always be secured in place with all mounting screws for operation and testing to provide a good rf ground to all stages of the receiver.

3.2 PERFORMANCE TESTS

3.2.1 General

Use the following tests to determine if the receiver rf and i-f board is operating properly. If testing produces unsatisfactory results, refer to the receiver rf and i-f troubleshooting chart (diagram DEPS-35320).

3.2.2 No-Signal Meter Reading Test

A failure in any part of the rf and i-f board will usually result in improper meter readings at one or more test positions. Perform checks at meter position 1 through 5 and compare the results with values shown in Table 1.

Table 1. Minimum Receiver RF & I-F Meter Readings (No Input Signal Applied)

Selector Switch Position	Reading (Micro-Amps)	Circuit Metered
1	10	Channel Element Output
2	15	First Doubler Output
3	10	Second Doubler Output
4+, 4−	0 ±2	Discriminator Output
5	10	Second I-F Amplifier & Limiter

3.2.2.1 Using the Portable Test Set

Step 1. The receiver rf and i-f board must be installed in a complete receiver chassis for testing. Make sure the rf and i-f circuit board mounting screws are all secure and that all connections to the board are properly made.

Step 2. Be sure the receiver shield is in place.

Step 3. Apply ac input power to the receiver.

Step 4. Using a TEK-37 Adapter Cable, connect a Motorola portable test set or meter panel to the receiver as follows:

- Connect the adapter cable 20-pin connector to the receptacle on the front of the test set or meter panel.
- Connect the adapter cable 7-pin white "metering" plug to the metering receptacle on the receiver rf and i-f board.

Step 5. Set the portable test set switches as follows:

- Set the function switch to the RCVR position.
- Set the meter reversing switch to the OFF position.
- Set the adapter cable SENS switch to the 100 mV position. If the adapter cable has no SENS switch, the unit operates at 100 mV all of the time.
- Set the adapter cable reference switch to position A or position B.

Step 6. Refer to the readings in Table 1. Set the test set selector switch to the positions called for in the table and observe the test set meter. Notice that the meter readings given in the table are minimums.

3.2.2.2 Input Voltages

3.2.2.2.1 If there are no test set indications at one or more of the metered points, check the dc input voltages to the receiver rf and i-f circuit board.

P904-9	A+ continuous (+13.8 V dc with reference to chassis)
P904-11	9.6 V dc continuous (with reference to chassis) (±0.5 V)
P904-8, 6	9.6 V dc continuous (with reference to chassis) (±0.5 V)

3.2.2.2.2 If test set indications localize the trouble to a specific stage or two, measure the dc input voltages to the suspected stages. Refer to the schematic diagram for the normal voltages.

3.2.2.3 Using Built-In Receiver Metering

Step 1. The receiver rf and i-f board must be installed in a complete receiver for testing. Make sure the rf and i-f circuit board mounting screws are all secure and that all connections to the board are properly made.

Step 2. Be sure the receiver shield is in place.

Step 3. Apply ac input power to the station.

Step 4. Plug the receiver service kit into the station.

NOTE

The receiver service kit will not operate unless the TKN6759A Cable Kit has been installed in the receiver.

It is not necessary to turn the metering POWER switch on. The switch should only be in the "on" position when the METER SELECTOR switch is set on position 6.

Step 5. Refer to the meter reading table in paragraph 3.2.2. Set the meter selector switch to the positions called for in the table and observe the meter. Notice that the meter readings given in the table are minimums.

3.2.2.4 20 dB Quieting Sensitivity Test

This performance test may be used after repair and alignment to assure that the receiver meets all specifications before it is returned to service. The receiver shield must be in place while performing this test.

- Using an AC Voltmeter and Portable Test Set

Step 1. Perform Steps 1 thru 5 in paragraph 3.2.2.1.

Step 2. Connect an ac voltmeter across pins 1 and 18 of the audio control module.

Step 3. (PL receivers only.) Disable PL, using the switch on the PL module.

Step 4. Set the receiver squelch control fully counter-clockwise (unsquelched).

Step 5. Adjust the LINE LEVEL control so the ac voltmeter reads 565 mV ac.

Step 6. Set the signal generator controls as follows:

- Set up the signal generator to produce a cw or unmodulated signal.
- Set the generator output level to maximum.
- Set the signal generator output frequency to the selected channel receive frequency. To set the signal generator on frequency without a frequency counter, adjust the generator frequency control until test set meter position 4 reads exactly zero.

Step 7. Slowly decrease the signal generator output level until the ac voltmeter reads 56.5 mV ac (20 dB down from 565 mV ac). Switch to a lower voltmeter scale if necessary.

NOTE

The output frequency of some signal generators will be "pulled" when the output level is near maximum. It may be necessary to reset the generator frequency to zero meter 4 as the output level is reduced.

Step 8. Note the signal generator output level. If the receiver rf and i-f board is functioning properly, this level should be 0.5 uV or less.

Step 9. Readjust the LINE LEVEL control as described in the Maintenance section of the manual.

3.2.2.5 Using Built-In Receiver Metering

Step 1. The receiver rf and i-f board must be installed in a complete receiver for testing. Make sure the rf and

i-f circuit board mounting screws are all secure and that all connections to the board are properly made.

Step 2. Be sure the receiver shield is in place.

Step 3. Apply ac input power to the receiver. Turn metering on.

Step 4. Unsquelch the receiver by turning the SQUELCH control fully counterclockwise. *Private-Line* stations must also be PL disabled.

Step 5. Set meter selector switch to POS 6 and the speaker switch to the "off" POS. Adjust the LINE LEVEL control for 50 uA as indicated on the meter.

Step 6. Connect an rf signal generator to the receiver input connector.

Step 7. Set the signal generator controls as follows:

- Set up the signal generator to produce a cw or unmodulated signal.
- Set the generator output level to maximum.
- Set the signal generator output frequency to the selected channel receive frequency. To set the signal generator on frequency without a frequency counter, adjust the generator frequency control until meter position 4 reads exactly zero.

Step 8. Slowly decrease the signal generator output level until METER POS 6 reads 5 uA.

NOTE

The output frequency of some signal generators will be "pulled" when the output level is near maximum. It may be necessary to reset the generator frequency to zero meter 4 as the output level is reduced.

Step 9. Note the signal generator output level. If the receiver rf and i-f board is functioning properly, this level should be 0.5 uV or less.

Step 10. Readjust the LINE LEVEL control as described in the Maintenance section of the manual.

3.3 FIRST MIXER REPLACEMENT PROCEDURE

3.3.1 General

3.3.1.1 Extreme care must be exercised in removing the mixer substrate. It is recommended that complete troubleshooting be performed to assure that the mixer is faulty before attempting replacement. No attempt should be made to repair individual substrate components, Rather, *the mixer should be replaced as an assembly*.

3.3.1.2 Two types of soldering irons are required to remove and replace the mixer. A chisel tipped iron of 150 watt rating is needed for connections to the rf deck. A small iron of 50 watt rating is required for substrate connections.

3.3.2 Replacement Procedure

Step 1. Remove the receiver rf and i-f board from the chassis.

Step 2. Unplug the mixer output cable from the rf and i-f board and remove the screws holding the cable lugs to the rf deck.

Step 3. Remove the four hex-Phillips screws which hold the mixer cavity shield.

Step 4. Using the large iron, unsolder the ground straps from the rf deck, adding solder as necessary to insure proper heat transfer.

Step 5. Carefully unsolder the two heavy gauge wire connections leading to pads at the top edge of the mixer substrate.

CAUTION

Prolonged heat or excessive strain at these connections may result in permanent damage to the substrate and associated components.

When both leads are free, bend the leads slightly to facilitate easy removal of the substrate.

Step 6. Lift the substrate VERTICALLY out of the rf deck.

Step 7. Press the nylon guides onto the edges of the replacement mixer substrate and carefully slide the unit into the rf deck.

Step 8. Using a large, well tinned iron, solder the ground straps to the rf deck. Remove excess solder to allow the cover to fit flush over the mixer cavity.

Step 9. Bend the heavy leads to conform to the pads on the substrate. The leads must be formed so that no strain is placed on the substrate when the leads are soldered in place. Use the minimum heat necessary to insure a good solder connection.

Step 10. Replace mixer cavity cover.

3.4 DOUBLE DOUBLER REPLACEMENT PROCEDURES

3.4.1 Assembly Replacement Procedure

Step 1. Disconnect the input coaxial cable (phono connector to printed circuit board) and the output cable (coaxial cable from the injection filter).

Step 2. Disconnect the 9.6 volt supply line (orange) at the printed circuit board.

Step 3. Remove the screws which fasten the input coaxial cable to the rf deck.

Step 4. Remove the three screws which fasten the quadrupler housing to the rf deck.

Step 5. Replace the new double doubler assembly in the reverse order of the above procedure.

3.4.2 Transistor Replacement Procedure

Using a 50 watt soldering iron and silver solder (silver content 2%), perform transistor replacement as follows.

Step 1. Carefully unsolder L201, L203, and R201 at the transistor pads and bend the components away from the transistor.

Step 2. Unsolder and remove the transistor.

Step 3. Remove excess solder from the substrate solder pads.

Step 4. Place the new transistor on the substrate pads. While holding the transistor in place with a tweezers, solder the emitter lead first and then the remaining leads. Be sure the transistor leads are positioned in the center of their respective substrate pads.

Step 5. Reposition L201, L203, and R201 and resolder their leads.

Step 6. Perform double doubler testing to insure unit is properly functioning.

3.5 TROUBLESHOOTING

3.5.1 Visual Inspection

3.5.1.1 The first step in the troubleshooting procedure should be a thorough visual inspection of the receiver and, in particular, the receiver rf and i-f board. Corrosion and burned or damaged components are usually easily seen and may be the cause of a symptom of the receiver malfunction. Loose circuit board mounting screws or a loose or improperly installed receiver shield are other easily found problems that can cause a considerable degradation in receiver performance.

3.5.1.2 After the obvious problems have been corrected, repeat the receiver rf and i-f board performance tests. If the tests still produce unsatisfactory results, refer to the receiver rf and i-f troubleshooting chart. The troubleshooting chart provides a systematic procedure for isolation of the defective stage and component.

3.5.1.3 As much information as possible has been included on the troubleshooting chart. However, you may have to refer occasionally to the receiver rf and i-f schematic diagram and circuit board detail. Detailed procedures regarding integrated circuits, troubleshooting, receiver gain measurements, and crystal dip tests follow in the text of this section of the manual.

3.5.2 Alignment as a Troubleshooting Technique

Low test set readings, improper discriminator output, and otherwise abnormal performance are very often corrected by realignment. Therefore, alignment should be one of the first troubleshooting steps performed for these symptoms.

3.5.3 Troubleshooting Integrated Circuits

3.5.3.1 Integrated circuits (ICs) are very reliable components and should not be replaced unless it is definitely indicated that the IC is the defective component. Before replacing an IC, make sure that the external components in the circuit are normal.

3.5.3.2 The ICs on the receiver rf and i-f board may be checked by dc voltage measurements. Proper voltages are shown in Table 2.

Table 2.
Nominal Receiver Integrated Circuit DC Voltages
(All readings are in volts dc, measured with respect to chassis)

Pin No.	U601 Voltage	U602 Voltage
1	GND	2.8
2	GND	GND
3	2.9	2.9
4	6.6	6.6
5	9.3	9.3
6	7.2	7.2
7	6.4	6.4
8	2.9	2.9
9	2.9	2.9
10	GND	GND

NOTE: All voltages may vary ± 10% from nominal readings shown.

3.5.4 Receiver Gain Measurements

A defective crystal in the i-f selectivity portion of the receiver can be located by measuring receiver gain voltages and performing crystal dip tests.

NOTE

Before making any receiver gain measurements, make sure the case of every filter crystal has a good conductive path to ground. An ohmmeter test should indicate less than 1 ohm between the crystal case and the receiver circuit board ground plating. A bad ground connection may cause errors in gain measurements.

Step 1. Proper receiver alignment is essential to this procedure. Complete receiver rf and i-f alignment. Leave alignment test equipment connected to perform this check.

Step 2. Refer to receiver gain measurements in Table 3, the rf and i-f schematic diagram, and the rf and i-f circuit board detail.

NOTE

Receiver rf input voltages given in Table 3 are those at the receiver input connector. If a pad or other attenuator is connected between the signal generator and the receiver rf input, the signal generator output control must be set to compensate for the loss in the pad.

Examples:

6 dB loss means V out of the pad = 1/2 V into the pad.

20 dB loss means V out of the pad = 1/10 V into the pad.

Step 3. Set the signal generator output frequency to the receiver channel frequency ("0" reading on meter 4). Adjust the signal generator output to provide the required receiver input voltage for a particular test point as listed in the table. Then, using an rf voltmeter, measure the rf signal voltage between the test point and a nearby chassis ground point. When using a high impedance rf probe (see Table of Recommended Test Equipment), the measured voltage at every test point should be within ±6 dB of the value given in Table 3.

Table 3. Receiver Gain Measurements

Test Point (See rf & i-f circuit board detail)	Receiver Input Voltage (preset)	Test Point Voltage (mV) ±6 dB	Remarks
L	50 mV	180	
M	50 mV	250	
N	50 mV	600	
O	50 mV	575	
P	50 mV	550	
Q	50 mV	500	
R	50 mV	250	U601
S	50 mV	800	saturated
T	20 uV	400	output
U	20 uV	375	
V	20 uV	350	
W	20 uV	300	U602
X	20 uV	75	saturated
Y	0	1000	output

Step 4. A high or low test point voltage measurement *may* indicate that the crystal at or ahead of the test point is defective. However, it may also indicate that an associated circuit component is defective. The extremely high-Q crystals used in *Micor* radios are very sensitive to associated circuit components. For example, if L601 is defective, it might appear that Y601 is bad. To isolate the defective component, perform the crystal dip tests described in the following procedure.

3.5.5 Crystal Dip Test

3.5.5.1 A defective crystal in the i-f selectivity portion of the receiver can be located by measuring receiver gain voltages and performing crystal dip tests.

3.5.5.2 The monolithic crystals used in *Micor* receivers are made up of two separate resonators on a single quartz blank. Each crystal has a pair of characteristic operating frequencies. One way to find the characteristic frequencies of each crystal is to short the crystal output to chassis ground, then monitor the crystal input voltage with an rf voltmeter while varying the signal generator frequency across the bandpass of the receiver. Low voltage points will occur at each of the crystal characteristic frequencies.

3.5.5.3 Figures 1 and 2 are plots of typical rf voltmeter readings obtained while testing good crystals. Note that the horizontal scales are calibrated in frequency, with f_o the channel frequency of the receiver. The vertical scales represent *relative* rf voltmeter readings. The bottom line is zero and the top line is maximum. Notice that each plot has a sharp minimum point above f_o and another below f_o. The table of crystal dip frequencies at the end of this section lists the frequencies at which these dip points should appear. If the measured dips fall outside the tolerances listed in the table, the crystal *may* be defective.

Step 1. Leave the test equipment set up as was done for the receiver gain measurements.

Step 2. Set the signal generator to f_o, the receiver channel frequency ("0" on meter 4). Adjust the generator output control for at least 50 mV *at the receiver input connector.*

Step 3. Refer to the crystal dip frequencies in Table 4. To test a particular crystal, find it in the table, ground the indicated test point, and connect an rf voltmeter between the monitored test point and a nearby chassis ground point.

Step 4. Starting at f_o, slowly increase the signal generator frequency while watching for a dip in the rf voltmeter reading. This dip should be sharp, so increase the signal generator frequency very slowly and watch the rf voltmeter closely. When the dip is found, write down the frequency counter reading.

Table 4. Crystal Dip Frequencies

Crystal	Test Point Grounded	Test Point Monitored	+ Frequency Dip (kHz) ±2.5 kHz	− Frequency Dip (kHz) ±2.5 kHz
Y601	O	N	4.5	9.0
Y602	Q	P	4.0	10.0
Y603	U	T	4.5	9.0
Y604	W	V	4.0	10.0

Step 5. Return the signal generator to f_o. Then watch the rf voltmeter while *slowly decreasing* the signal generator frequency. When the dip is found, write down the frequency counter reading.

Step 6. Compare your test results with the frequencies and tolerances listed in the table for the crystal you have tested. If the measured dips fall outside the tolerances listed in the table, the crystal *may* be defective. Continue with this procedure to isolate the bad component.

Step 7. FOR TEST PURPOSES ONLY, exchange the suspected crystal with another from the receiver. Be sure you note the polarity of the crystal when you make the change. Repeat the receiver gain measurement and crystal dip test on the suspected crystal in the new location. If the suspected crystal tests bad again, consider it defective and replace it. If the crystal tests good, look for defective associated components at the original crystal location.

Step 8. When the tests are completed, be sure *all* jumpers connected during the test are removed and that any *moved crystals are returned to their original locations*. Refer to the parts list and circuit board detail for correct part location. Note crystal polarity when replacing crystals.

3.5.6 Double Doubler Troubleshooting

Disconnect the input coaxial cable (phono connector to printed circuit board). Test the second doubler output. If the second doubler is operating properly, reconnect the double doubler input coaxial cable to the 2nd doubler. Disconnect the double doubler output cable. Using a 50 ohm probe, rated for at least 1000 MHz, test the double doubler output voltage. A minimum reading of 70.7 millivolts should be obtained. If the minimum reading is not obtained, check the dc voltages on the schematic.

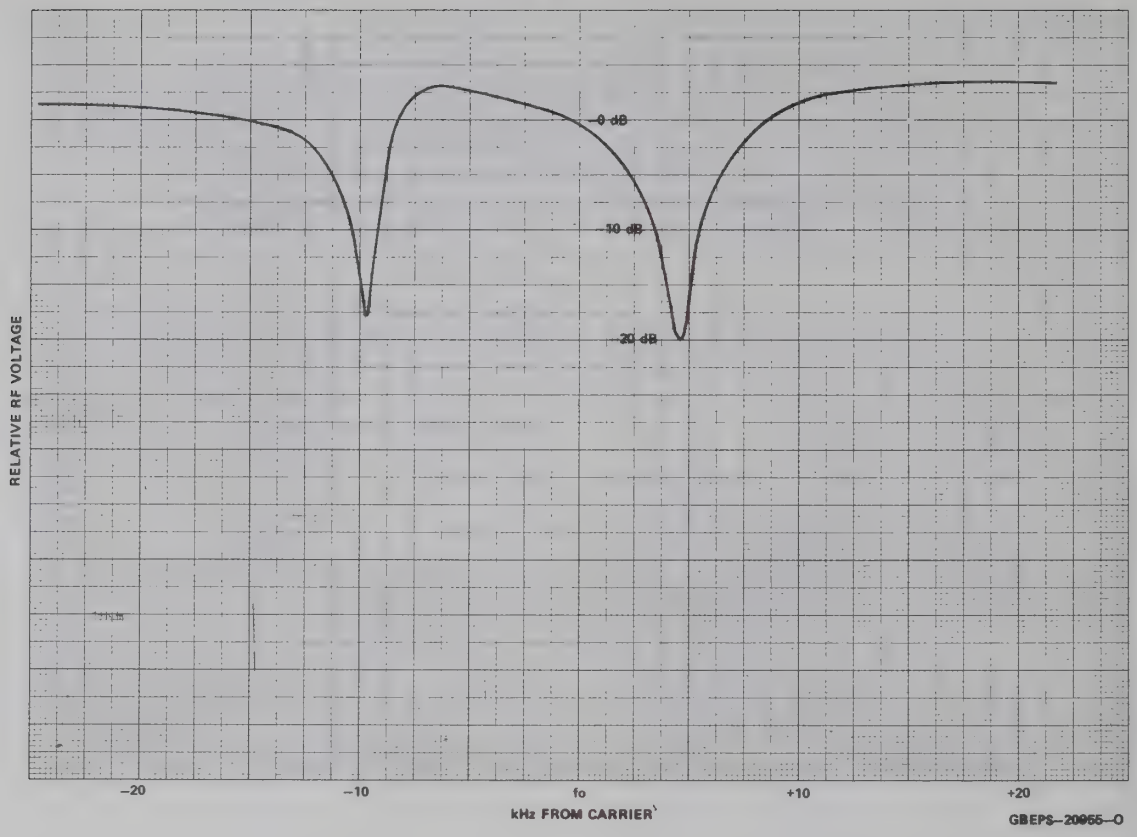


Figure 1. Typical Plot of a Known Good Crystal in Position Y601 or Y603

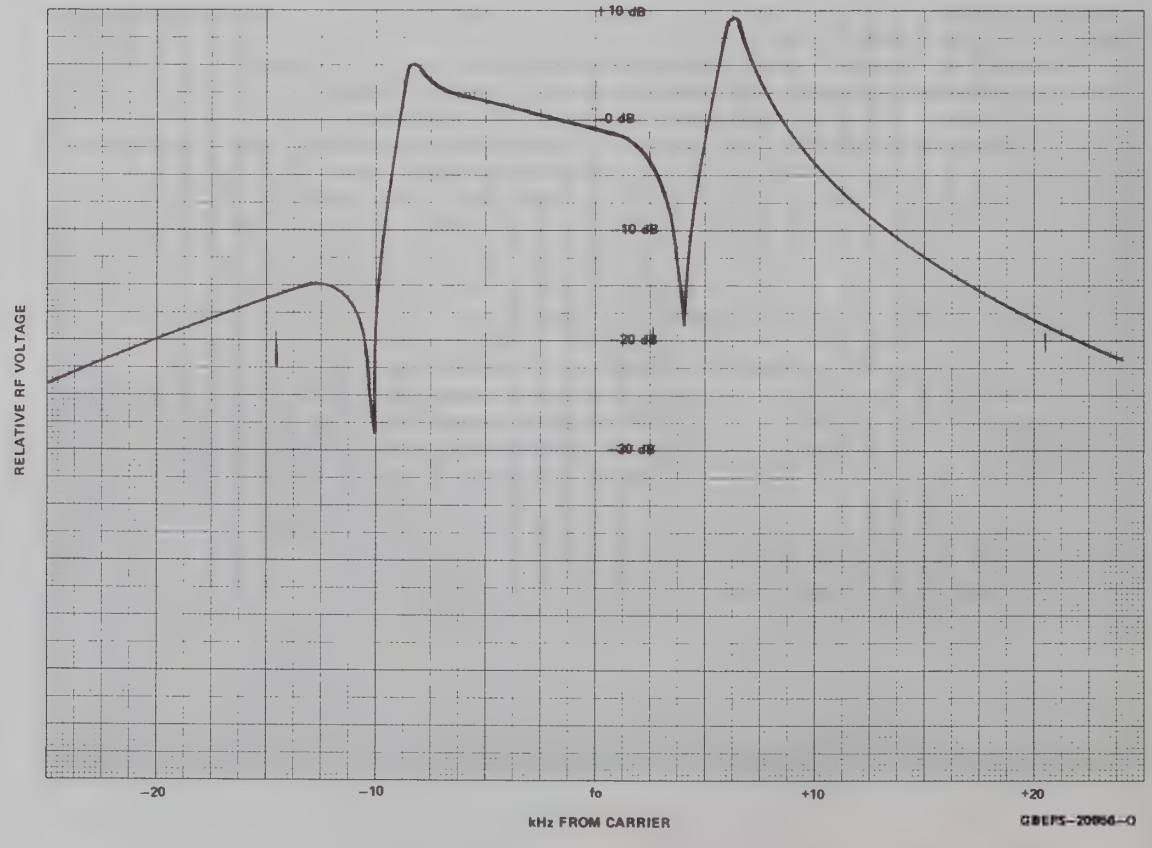


Figure 2. Typical Dip Plot of a Known Good Crystal in Position Y602 or Y604

. CHECK SUPPLY VOLTAGE ON SECOND MIXER.
. PERFORM SUPPLY TESTS GIVEN ON THIS CHART. TABLE II.
. PERFORM STAGE GAIN TESTS AND CRYSTAL DIP TESTS. REFER TO TEXT FOR PROCEDURES.

CHECK DC VOLT– AGES ON 2ND DOUBLER ACCORDING TO SCHEMATIC DIAGRAM.

EGRATED CIRCUIT

VOLTS DC,
T TO CHASSIS)

U602 VOLTAGE
2.8
GND
2.8
6.6
9.3
7.2
6.4
2.8
2.8
GND

ARY +10% FROM HOWN.

TRF1032A RF and I-F Board
Troubleshooting Chart
Motorola No. DEPS-35320-O
12/1/82- UP

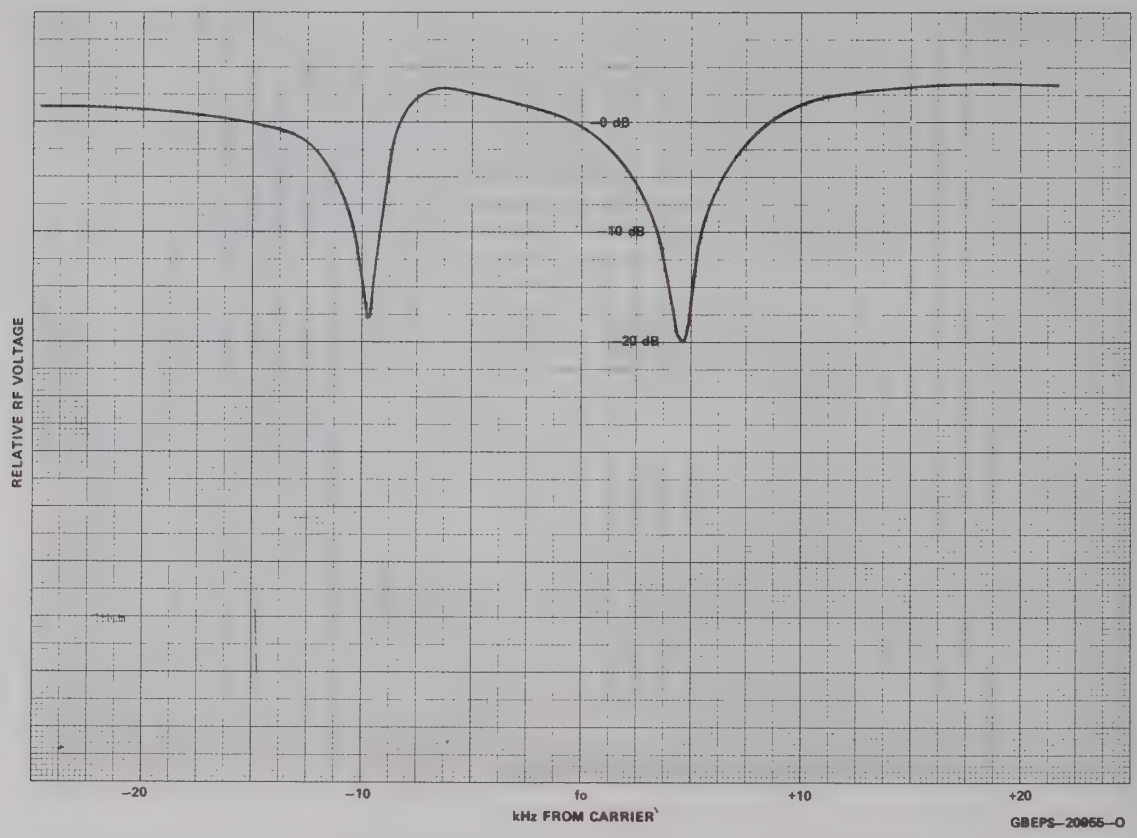


Figure 1. Typical Plot of a Known Good Crystal in Position Y601 or Y603

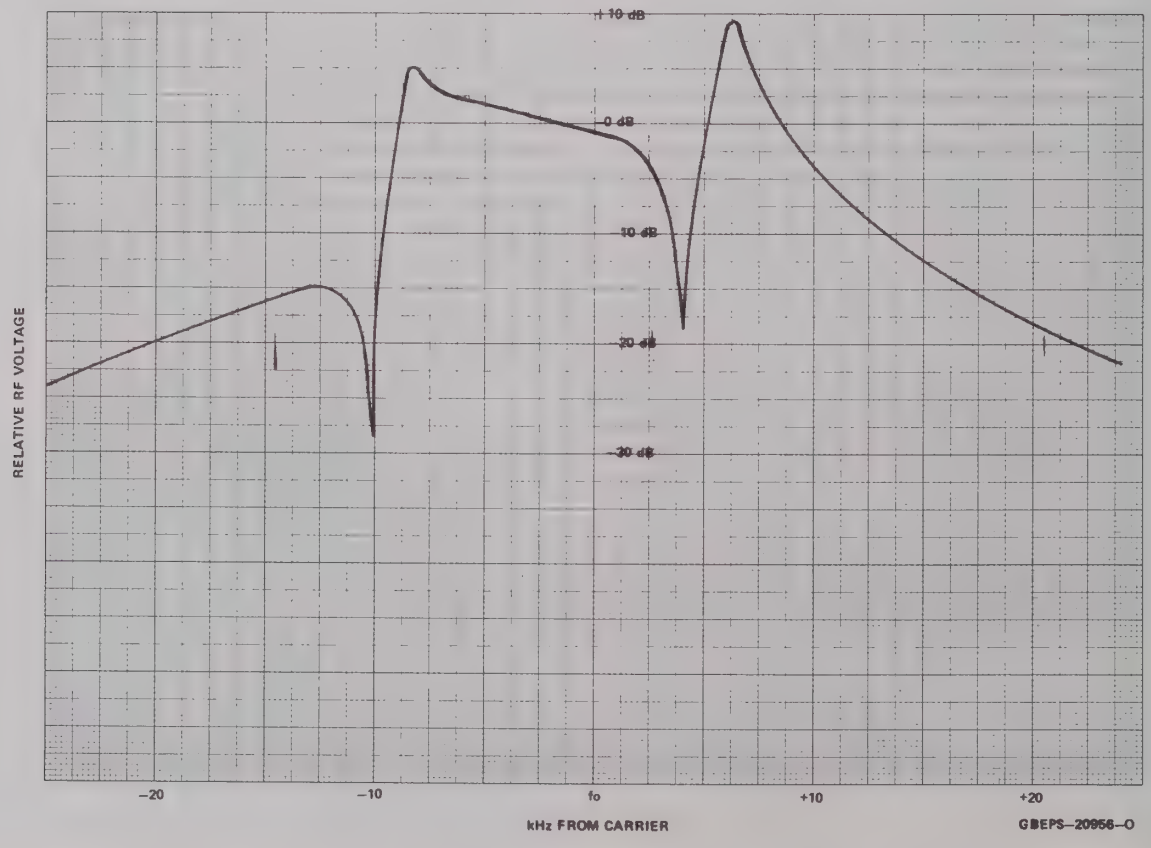
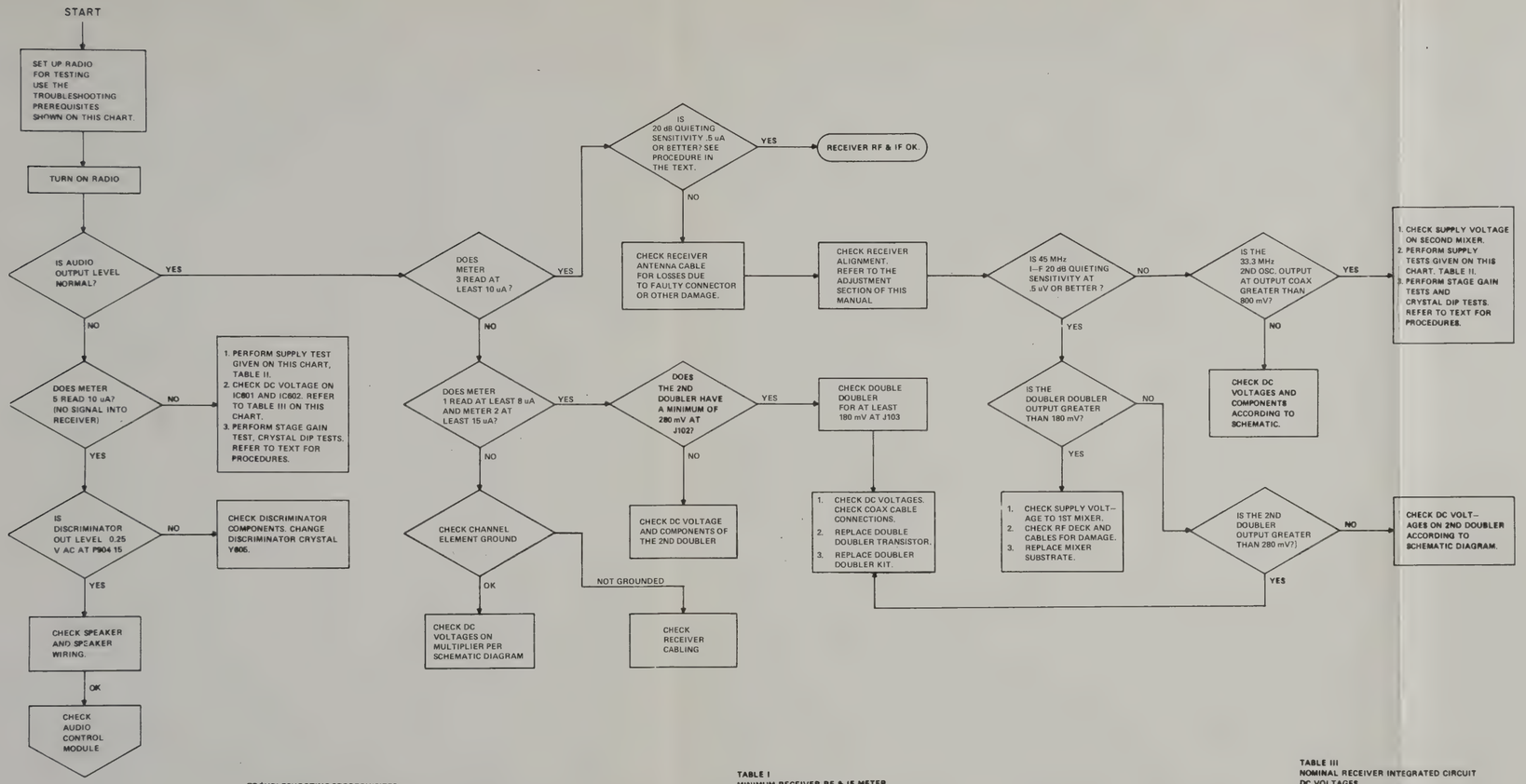


Figure 2. Typical Dip Plot of a Known Good Crystal in Position Y602 or Y604



TROUBLESHOOTING PREREQUISITES

1. THE RECEIVER RF & IF BOARD MUST BE INSTALLED IN A COMPLETE RECEIVER FOR TESTING. BE SURE ALL CIRCUIT BOARD MOUNTING SCREWS ARE SECURE, SHIELDS INSTALLED, AND THAT ALL CONNECTIONS TO THE BOARD ARE PROPERLY MADE.
2. USING A TEK–37 ADAPTER CABLE, CONNECT A MOTOROLA PORTABLE TEST SET OR METER PANEL TO THE RADIO AS FOLLOWS:
   - A. CONNECT THE ADAPTER CABLE 20–PIN CONNECTOR TO THE RECEPTACLE ON THE FRONT OF THE TEST SET OR METER PANEL.
   - B. CONNECT THE WHITE "METERING" PLUG TO THE METERING RECEPTACLE ON THE RECEIVER RF AND IF BOARD.
3. SET PORTABLE TEST SET SWITCHES AS FOLLOWS:
   - A. FUNCTION SWITCH TO THE RCVR POSITION.
   - B. METER REVERSING SWITCH TO OFF POSITION.
   - C. ADAPTER CABLE SENS SWITCH TO THE 100 mV POSITION. IF THE ADAPTER CABLE HAS NO SENS SWITCH, THE UNIT OPERATES AT 100 mV ALL OF THE TIME.
   - D. ADAPTER CABLE REFERENCE SWITCH TO POSITION A OR B.
   - E. D. SELECTOR SWITCH AS REQUIRED BY THE TROUBLESHOOTING PROCEDURE.
4. ON "PRIVATE–LINE" RADIOS, DISABLE THE PL MODULE.
5. SET THE SQUELCH CONTROL FULLY COUNTERCLOCKWISE (UNSQUELCHED).
6. SET THE VOLUME CONTROL FOR A COMFORTABLE LISTENING LEVEL.
7. HIGH RF FREQUENCY MEASUREMENTS SHOULD BE MADE WITH AN ACCURATE METER SUCH AS THE MOTOROLA S1339A (SEE EQUIPMENT LIST).

TABLE I
MINIMUM RECEIVER RF & IF METER READINGS TABLE
(NO INPUT SIGNAL APPLIED)

SELECTOR SWITCH POSITION	READING (MICRO–AMPS)	CIRCUIT METERED
1	8	CHANNEL ELEMENT OUTPUT
2	15	FIRST DOUBLER OUTPUT
3	10	SECOND DOUBLER OUTPUT
4	0 ± 2	DISCRIMINATOR OUTPUT
5	10	SECOND I–F AMPLIFIER AND LIMITER

TABLE II
RECEIVER RF & IF DC INPUT VOLTAGES

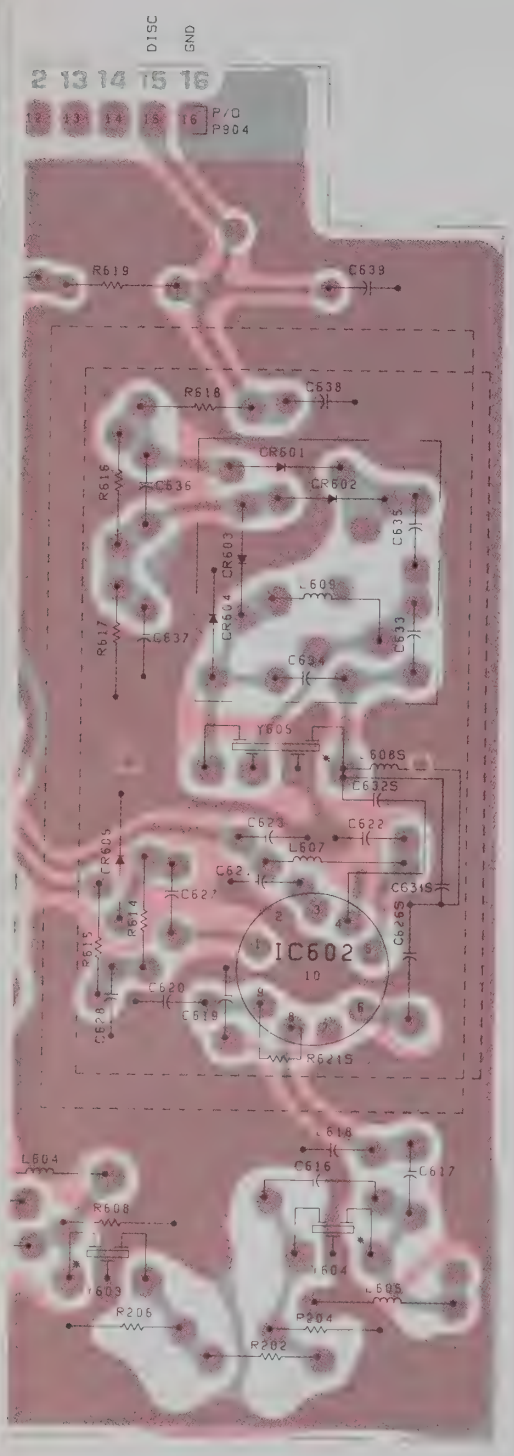
TEST POINT	DESCRIPTION
P904–9	B+ CONTINUOUS (+13.8 V DC WITH REFERENCE TO CHASSIS)
P904–11	9.6 V DC CONTINUOUS (WITH REFERENCE TO CHASSIS) (±0.5 V)
P804–8,6	9.6 V DC CONTINUOUS (WITH REFERENCE TO CHASSIS) (±0.5 V)

TABLE III
NOMINAL RECEIVER INTEGRATED CIRCUIT DC VOLTAGES
(ALL READINGS ARE IN VOLTS DC, MEASURED WITH RESPECT TO CHASSIS)

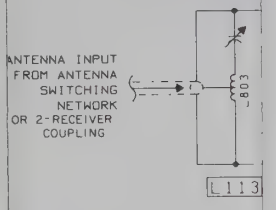
PIN NO.	U601 VOLTAGE	U602 VOLTAGE
1	GND	2.8
2	GND	GND
3	2.8	2.8
4	8.6	8.6
5	9.3	9.3
6	7.2	7.2
7	8.4	8.4
8	2.8	2.8
9	2.8	2.8
10	GND	GND

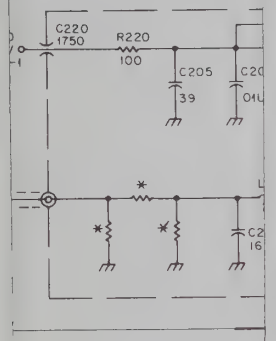
NOTE: ALL VOLTAGES MAY VARY ±10% FROM NOMINAL READINGS SHOWN.

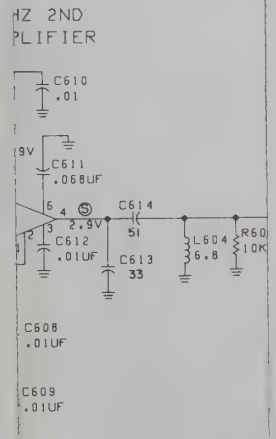
TRF1032A RF and I-F Board Troubleshooting Chart
Motorola No. DEPS-35320-O
12/1/82- UP



COMPONENT SIDE BD-EEPS-24370-0
SOLDER SIDE BD-EEPS-24371-0
OL-EEPS-24372-A

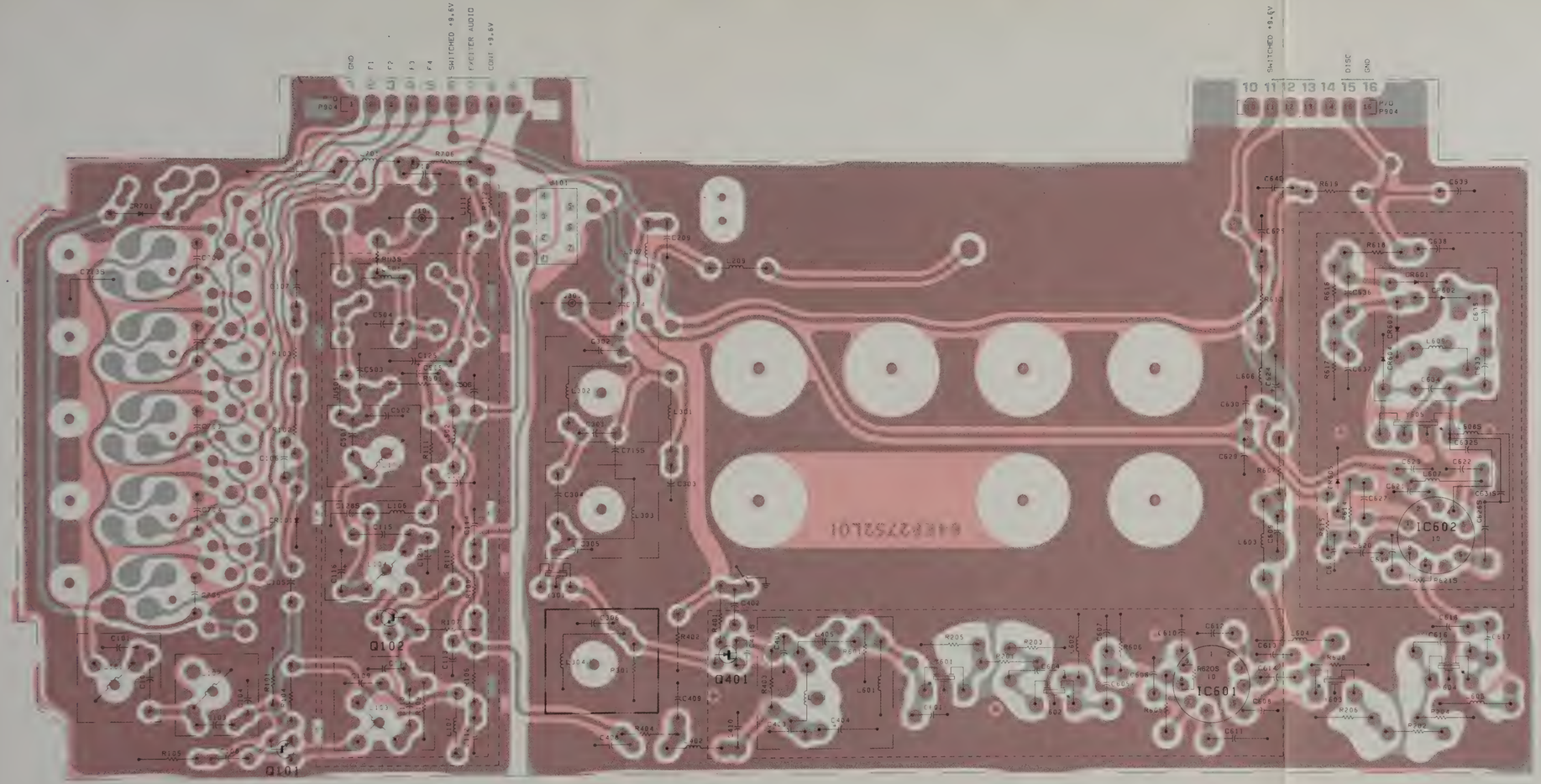






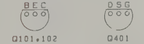
PARTS LISTS SHOWN ON BACK OF THIS DIAGRAM

TRF1032A RF and I-F Board
Schematic Diagram and Circuit Board Detail
Motorola No. ***PEPS-35631-O***
(Sheet 2 of 2)
12/1/82- UP



SHOWN FROM SOLDER SIDE

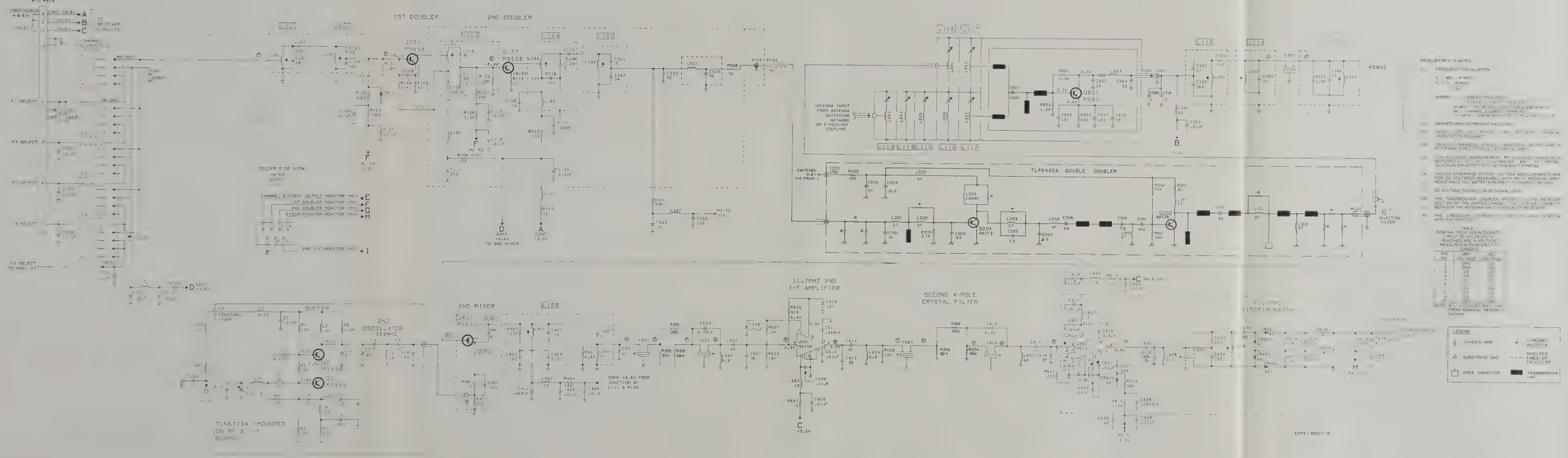
TRANSISTOR LEAD DETAILS (BOTTOM VIEW)



— — — SHIELD ON COMPONENT SIDE
– – – – SHIELD ON SOLDER SIDE
PARTS ENDING IN 'S' ARE ON SOLDER SIDE
*–INDICATES CRYSTAL POLARITY

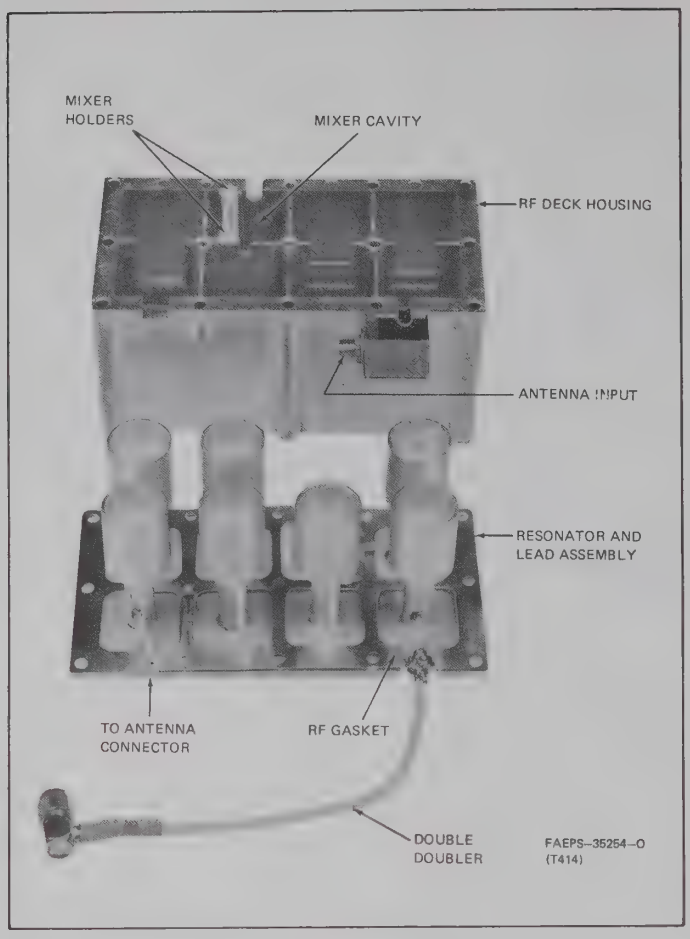
COMPONENT SIDE ▨ BD-EEPS-24370-O
SOLDER SIDE ▩ BD-EEPS-24371-O
BD-EEPS-24372-A

TRF1032A RF and I-F Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-35631-O
(Sheet 1 of 2)
12/1/82- UP

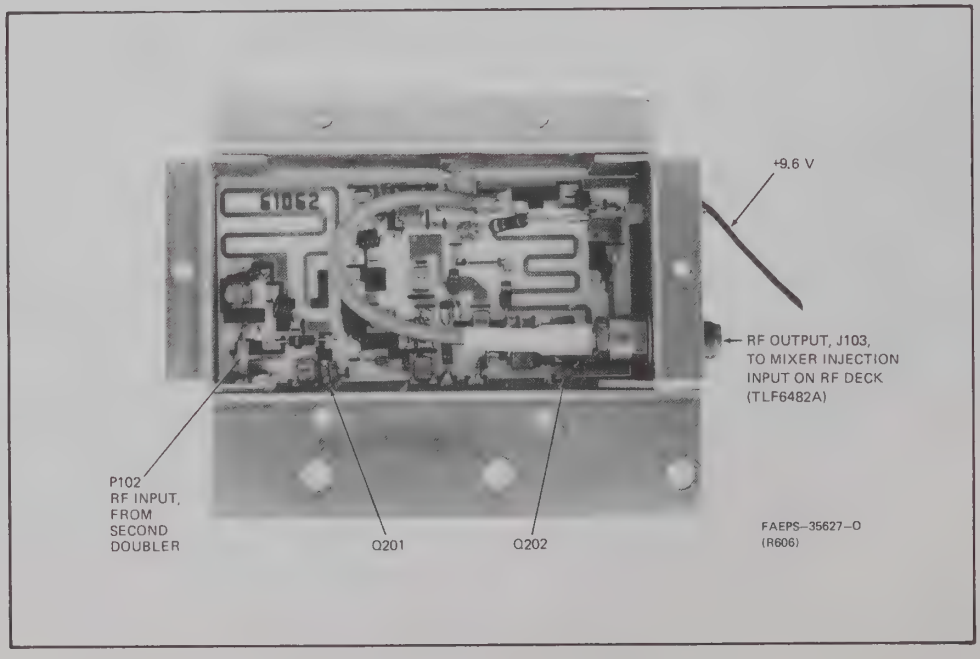


PARTS LISTS SHOWN ON BACK OF THIS DIAGRAM

TRF1032A RF and I-F Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-35631-O
(Sheet 2 of 2)
12/1/82-LTP



RF DECK



DOUBLE DOUBLER

RF TECHNICAL CHARACTERISTICS

Range	928-960 MHz
ing	25 kHz
on Acceptance	±8 kHz minimum
	Channel element maintains receiver frequency within ±0.0002% of reference frequency from −30°C to +60°C ambient temperature (+25°C reference).
nce	50 ohms
20 dB Quieting	0.5 uV
EIA Sinad	0.35 uV
A Sinad)	−80 dB @ ±25 kHz
ermodulation	−75 dB
Image Rejection	100 dB minimum
ivity elch (adjustable)	0.25 uV or less at threshold
quelch	0.25 uV or less
Squelch	0.25 uV or less

parts list

TRN6112C Receiver RF and I.F Board — PL-8215-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ± 5%; 500 V: unless otherwise stated
C101	21-82133X74	24, N150
C102	21-82450B29	6.5†
C103	21-84483B44	33
C104	21-82610C44	100
C105	21-857336	2 ± .2
C106, 107	21-82428B59	.01 uF ± 80-20%; 200 V
C108	21-82356B28	10 ± .25
C109	21-82187B11	.0015 uF ± 10%; 100 V
C110	21-838917	8 ± .25
C111	21-82610C14	30
C112	21-82187B08	220 ± 10%
C113, 114	21-82428B39	.01 uF + 80%-20%; 200 V
C115	21-82450B35	0.2 ± 10%
C116	21-82187B06	220 ± 10%
C117	21-831125	100 ± 10%; 300 V
C124	21-857336 - 2	2
C125	23-84782H04	2.2 uF ± 20%
C126	21-840385	24
C209	21-82187B20	1000 ± 10%; 100 V
C301	21-83406D37	27
C302	21-84534B05	180
C303	21-82428B59	.01 uF + 80-20%; 200 V
C304	21-82450B08	1.2
C305	21-82133G48	24
C306	21-82133G82	22
C307	21-82610C28	110, 200 V
C402	21-82187B31	1500 ± 10%; 200 V
C403	21-82610C03	47; 200 V
C404	23-84782H04	2.2 uF ± 20%; 25 V
C405	21-82450B11	3; 500 V
C406, 408	21-82428B39	.01 uF + 80-20%; 200 V
C410	21-82095G04	.068 uF ± 10%; 50 V
C411	21-840848	6 pF ± .5 pF
C501	21-82610C94	3 ± .1
C502	21-840365	24
C503, C504	21-83406D89	10
C505	21-82428B59	.01
C506	21-82187B08	220
C601	21-851845	11; NPO
C604	21-82450B07	0.39
C605	21-83406D44	47 ± 0.5%; NO80
C606	21-82428B59	.01 uF + 80-20%; 200 V
C607	21-82610C14	30 pF ± 5 pF; N150
C608	21-82428B59	.01 uF + 80-20%; 200 V
C609, 610	21-82428B59	.01 uF + 80-20%; 200 V
C611	8-8381H05	.068 uF ± 10%; 100 V
C612	21-82428B59	.01 uF + 10%; 200 V
C613	21-82356B08	33 ± 0.5%; NP0
C614	21-82610C29	51 ± 0.5%; N150
C616	21-82450B01	0.30 ± 0.5%
C617, 618	21-83406D37	27 ± 0.5%; N150
C619, 620	21-82428B59	.01 uF + 80-20%; 200 V
C621, 622, 623, 624	23-84782H04	2.2 uF ± 20%; 25 V
C625	21-82428B59	.01 uF + 80-20%; 200 V
C626	8-8381H06	10 uF ± 10%; 100 V
C627	21-82187B08	220
C628	21-82428B57	.0033 uF ± 10%; 200 V
C629	21-82428B59	.01 uF + 80-20%; 200 V
C630	21-84483B24	40
C631	21-82610C07	51; 200 V
C632	21-861443	.01 uF + 100-20%; 75 V
C633, 634, 635, 636, 637	21-83786B01	100; 200 V
C638, 639	21-82187B30	470 ± 10%
C640	21-82428B59	.01 uF + 80-20%; 200 V
C701 thru 705	21-82428B59	.01 uF + 80-20%; 200 V
C711	23-84782H03	10 uF ± 10%; 20 V
C712	21-82428B56	.01 uF + 80-20%; 200 V
C713	21-82187B11	.0015 uF ± 10%; 100 V
C714	21-00860054	13; N330
C715	21-840848	6 pF ± 0.5 pF
		diode (see note)
CR101	48-82139G01	germanium
CR601 thru 604	48-84616A01	hot carrier
CR605	48-82139G01	germanium
CR701	48-82382B03	silicon
		connector, receptacle:
J101	9-84207B01	female; 7 contact
J102, J301	9-84231B02	female; single contact
		coil, rf:
L101	24-84972A15	8-1/2 turns; BRN
L102	24-84972A16	6-1/2 turns; RED
L103	24-84972A17	8-1/2 turns; ORG
L104	24-83857G07	12 turns; multiplier
L105	24-83857G05	14-1/4 turns; multiplier
L106, 107	24-83961B01	3 turns; BRN
L111	24-83961B01	3 turns; BRN
L207	24-82723H07	choke; 10 uH
L209	24-82723H05	choke; 0.41 uH; YEL
L301	24-82723H07	choke; 10 uH
L302 thru 304	24-84113B01	7-1/2 turns; BRN

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
L401	24-84256B05	GRN
L402	24-82723H07	choke; 10 uH
L501	24-83884G01	choke; molded
L502	24-83961B01	3 turns; BRN
L801	24-82546D25	choke; 10 uH
L802	24-84256D02	choke; 6.8 uH
L803	24-82723H07	choke; 10 uH
L804, 805	24-84256D02	choke; 6.8 uH
L806, 807	24-82723H07	choke, 10 uH
L808	24-84256D03	choke, 2.2 uH
L809	24-83879G04	20 turns; YEL
L701	24-83961B01	3 turns; BRN
L801 thru 807	1D83010K03	resonator and lead assy,
L808	75-83960B01	ferrite bead
L809	24-82723H05	choke; 0.41 uH
P301	28-84282D01	**connector, plug:** male; single-contact
P102	28-87317C01	male; single contact
Q801	48-868670	**transistor: (see note)** NPN; MS870
R801, 802, 803		cannot be replaced
		mechanical parts
	3-134268	SCREW, tapping; 4-40 x 7/16"; 4 req'd.
	15-84630E01	COVER, connector (J801)
	42-83033K01	HOLDER; 2 req'd.
	84-83018K02	PLATE, cover
	29-5227	LUG, soldering; #6; 2 req'd.
	15-83014K01	HOUSING, rf deck
	2-84733E03	NUT, tension; 7 req'd.
	3-84997K01	SLUG TUNING; 7 req'd.
	42-82107L02	GASKET
	3-136138	SCREW, tapping; 8-32 x 3/8"; 11 req'd.
	32-82550M01	GASKET, lead

note: For optimum performance, diodes, translators, and integrated circuits must be ordered by Motorola part numbers.

TRN6713A 2nd Oscillator Kit — PL-8217-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ± 5%; unless otherwise stated
C1	20-82309D04	variable; 5.5-18 pF
C2	21-82428B59	.01 uF + 80-20%; 200 V
C3	21-821474	470 pF ± 20%; 500 V
C4	21-82355B09	33 pF; 500 V
C5	21-831125	100 pF ± 10%; 300 V
C6	21-82187B14	.001 uF ± 10%; 100 V
C7	21-84395B01	46 pF; 500 V
C8	21-840848	6 pF ± 0.5 pF; 500 V
C9	21-82610C44	100 pF ± 10%; 100 V
C10	21-82860E33	80 pF; 500 V
C11	21-82187B14	.001 uF ± 10%; 100 V
C12	21-840848	6 pF ± 0.5 pF; 500 V
C13	21-82204B22	5 pF; 250 V
L1	24-82723H04	**coil, rf:** choke; 0.29 uH
L2	24-82723H05	choke; 0.41 uH
L3	24-890657	choke, 2.0 uH
L4	24-82723H01	choke; 1.2 uH
L5	24-82723H05	choke, 0.41 uH
Q1, 2	48-869494	**transistor: (see note)** NPN; type MS494
R1, 2	6-124C77	**resistor, fixed: ± 10%; 1/4 W:** unless otherwise stated 15k
R3	6-124C51	1.2k
R4	6-124C77	15k
R5	6-124A37	330 ± 5%
R6	6-124A53	1.5k ± 5%
Y1	48-83860F09	**crystal:** 33.3 MHz
		mechanical parts
	3-139012	SCREW, 4-40 x 1/4"
	4-474218	WASHER, 2 req'd.
	15-82304L01	COVER
	43-83066F05	BUSHING; 0.250" length; 2 req'd.
	43-83066F06	BUSHING, 0.170" length
	43-83617D01	BUSHING, round
	14-84602K02	INSULATOR, crystal; 2 req'd.
	26-82303L01	SHIELD
	43-82505L01	SPACER, threaded (oscillator shield)

note: For optimum performance, diodes, translators, and integrated circuits must be ordered by Motorola part numbers.

TLN5891A Receiver Shield Kit — PL-8217-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-139495	SCREW, tapping; 6-32 x 9/16"; 8 used
	26-82840L01	SHIELD

TRF5482A RF Deck — PL-8216-O

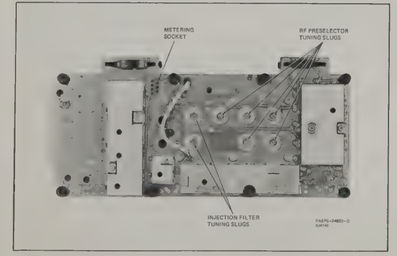
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ± 20%; 500 V: unless otherwise stated
C801	21-84547A01	1000 20%; 50 V
C802	21-84547A05	10000 pF
C803	21-84736E12	39 pF ± 5%; 500 V
C804	21-84473H17	56 pF ± 10%; 50 V
C805	21-84547A05	10000 pF
C806	21-84736E12	39 pF ± 5%; 500 V
J102	8-82547L02	**connector, receptacle:** female; single contact
L801 thru 807	1D83010K03	**coil, rf:** resonator and lead assy,
L808	75-83960B01	ferrite bead
L809	24-82723H05	choke; 0.41 uH
P301	28-84282D01	**connector, plug:** male; single-contact
P102	28-87317C01	male; single contact
Q801	48-868670	**transistor: (see note)** NPN; MS870
R801, 802, 803		cannot be replaced
		mechanical parts
	3-134268	SCREW, tapping; 4-40 x 7/16"; 4 req'd.
	15-84630E01	COVER, connector (J801)
	42-83033K01	HOLDER; 2 req'd.
	84-83018K02	PLATE, cover
	29-5227	LUG, soldering; #6; 2 req'd.
	15-83014K01	HOUSING, rf deck
	2-84733E03	NUT, tension; 7 req'd.
	3-84997K01	SLUG TUNING; 7 req'd.
	42-82107L02	GASKET
	3-136138	SCREW, tapping; 8-32 x 3/8"; 11 req'd.
	32-82550M01	GASKET, lead

note: For optimum performance, diodes, translators, and integrated circuits must be ordered by Motorola part numbers.

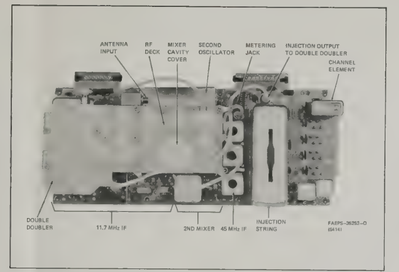
TLF5492A Double Doubler Board (Rcvr.) — PL-8244-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF; 50 V: unless otherwise stated
C201	21-84736E08	16 ± 5%
C202	21-84736E15	5.6 ± 0.5 pF
C203	21-84736E16	5.6 ± 0.25 pF
C204	21-84547A05	.01 uF ± 20%
C205	21-84736E12	39 ± 5%
C206	21-84736E31	56 ± 10%
C207	21-84736E17,	6.8 ± 0.5 pF
C210	21-84736E29	7.5 ± 0.25 pF
C211	21-84736E21	100 ± 5%
C212	21-84736E12	39 ± 5%
C220	91-87511C01	RFI, 1700
J103	9-87318C04	**connector, receptacle:** female, panel mounting
L201	24-84311M22	**coil, rf:** 2-turns
L202	24-84311M39	5-turns
L203	24-84331M44	3-turns
L204	24-82723H40	290 nH
L205, 206	24-84331M10	4-turns
L210	24-84331M44	3-turns
L211	24-84331M47	7-turns
L212	24-84331M22	2-turns
L213	24-84331M45	4-turns
P102	28-84282D01	**connector, plug:** phono, male
Q201	48-84411L73	**transistor: (see note)** NPN; MI173
Q202	48-84411L74	NPN; type MI1174
R201	6-185B84	**resistor, fixed: ± 5%; 1/8 W:** 2.7 kohms ± 10%
R210	6-185A77	15k
R211	6-185A49	560
R212	6-185A23	82
R220	6-185A25	100
W1	1-807918B3	**cable assembly:** consists of: ref. item P102
	30-83794C01	CABLE, coaxial; 11" used
	29-5227	LUG, solder; 2 used
W201	1-80784D86	consists of: ref. item J103
	30-859004	CABLE, coaxial; 3.5" used
		mechanical parts
	29-83208M01	LUG, solder
	3-134189	SCREW, tapping; 4-40 x 1/4"; 8 used
	15-82575L01	HOUSING, quadrupler
	30-10151A17	WIRE, flat
	84-82576L01	PLATE, cover
	39-10184A24	CONTACT, receptacle

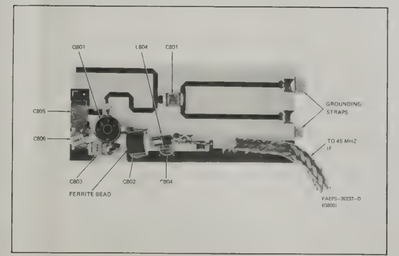
note: For optimum performance, diodes, translators, and integrated circuits must be ordered by Motorola part numbers.



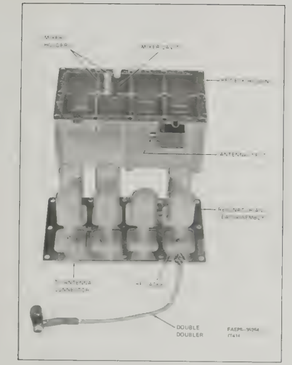
RECEIVER REAR VIEW



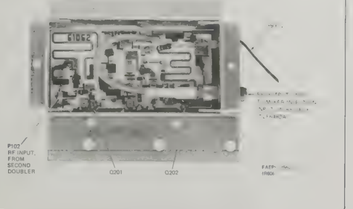
RECEIVER FRONT VIEW



MIXER BOARD



RF DECK



DOUBLE DOUBLER

RECEIVER ALIGNMENT PROCEDURE

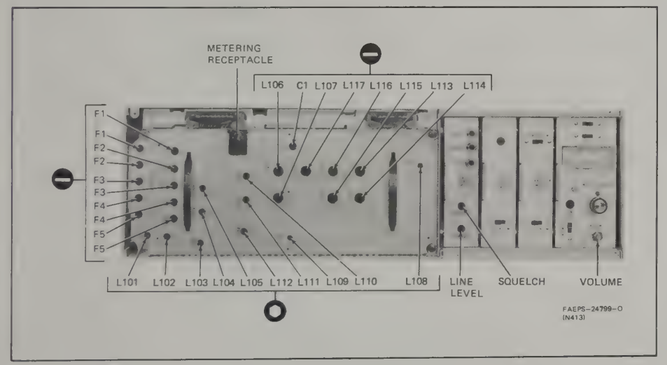
A. FREQUENCY CALCULATIONS

Where:

f_o = channel element frequency
f_c = carrier frequency

$$f_o = \frac{f_c - 45\ \text{MHz}}{48}$$

B. RECEIVER ADJUSTMENT LOCATIONS



C. MINIMUM RECEIVER METER READINGS
(NO INPUT SIGNAL APPLIED)

Test Set Selector Switch Position	Reading (uA)	Circuit Metered
1	10	Channel Element Output
2	15	First Doubler Output
3	10	Second Doubler Output
4+, 4−	0 ±2	Discriminator Output
5	10	Second I-F Amplifier and Limiter

D. RECEIVER ALIGNMENT

Step	Adjust	Meter Position	Stage and Procedure
1	L101, L102, L103, L104, L105		MULTIPLIER COILS — Adjust the cores of L101, L102, L103, and L105 to the end of the coil form flush with the printed circuit board. Adjust the core of L104 to the end of the coil form away from the printed circuit board.
2	L110, L111, L112		FIRST I-F COILS — Adjust the cores of L110, L111, and L112 to the end of the coil form flush with the printed circuit board.
3	L106, L107, L113, L114, L115, L116, L117		PRESELECTOR AND INJECTION FILTER — Adjust the slugs at L106, L107, and L113 through L117 away from the rf deck until they stop. Adjust L106 four turns clockwise and L117 two turns clockwise.
4	L101, L102	1	CHANNEL ELEMENT OUTPUT — Adjust L102 two turns clockwise. Alternately turn L101 and L102 clockwise 1/2 turn at a time until a peak indication is achieved on meter 1.
5	L103, L104	2	FIRST DOUBLER — Tune L103 for a peak reading on meter 2. Tune L104 counterclockwise until meter 2 dips.
6	L104, L105	3	DOUBLE DOUBLER — Tune L105 clockwise until a peak reading is achieved on meter 3. Tune L104 until a peak reading is achieved on meter 3. Repeak L104 and L105 until no further improvement is obtained.
7	L108	4, 5	DISCRIMINATOR — Insert the center conductor of the output cable from a 11.7 MHz test oscillator into the L109 hole on the receiver shield. Do not contact the circuit board. Insert the conductor far enough to obtain a saturated reading on meter 5. By tuning L108, it should then be possible to obtain readings on either side of zero (center) on meter 4. Tune L108 for an EXACT zero (center) reading. *This adjustment is critical.*
8	L109	5	SECOND I-F COIL — Insert the 11.7 MHz injection probe into the L112 hole in the receiver shield. Tune L109 for a peak reading on meter 5, keeping meter 5 out of saturation by moving the probe.
9	C1	4, 5	SECOND OSCILLATOR WARP CAPACITOR — Insert the 45 MHz injection probe into the L112 hole in the receiver shield. Tune C1 until quieting is obtained and meter 5 increases. Tune C1 for an EXACT zero reading on meter 4. *This adjustment is critical.*
10	L110, L111, L112	5	FIRST I-F COILS — Insert the 45 MHz injection probe in the L110 hole on the receiver shield. Tune L112 clockwiise for a peak reading on meter 5, keeping the meter out of saturation by moving the probe. Tune L111 clockwise for a peak reading on meter 5, keeping the meter out of saturation. Remove the probe and turn L110 ten turns clockwise.
11	L106	4, 5	INJECTION FILTER — Unsquelch the receiver and connect an rf signal generator to the antenna connector. Set the rf output level of the generator to maximum and set the generator to the carrier frequency. Tune L106 for a peak reading on meter 5, reducing the generator level as necessary to keep meter 5 out of saturation.
12	L107, L105, L104	3, 5	Detune L105 until meter 3 drops to 10 uA. Tune L107 for a peak reading on meter 5. Tune L105 for a peak reading on meter 3. Repeak L104 and L105 until no further improvement is obtained.
13	L113, L114, L115, L116, L117	5	RF PRESELECTOR — Tune L117, L116, L113, L114 and L115 in that order for a peak reading on meter 5. Reduce the generator level as necessary to keep meter 5 out of saturation.
14	L113, L114, L115, L116, L117	5	Tune L113, L114, L115, L116, L117 in that order for best noise quieting.
15	L110, L111, L112, L109	5	FM modulate the carrier frequency with a 1 kHz tone at 7.5 kHz deviation. Peak L110, L111, L112, and L109 in that order for a maximum reading on meter 5.
16	F1	4	Adjust F1 channel element. Inject a known, accurate carrier frequency into the receiver. Adjust the channel element warp capacitor for a zero reading on meter position 4.
17	—	—	Perform 20 dB quieting sensitivity measurements to check alignment.

MODEL TABLE

Model	Model Breakdown	Description
TRF1032A	TRF1181A	RF Injection Deck
	TRF6112A	Receiver RF & I-F Board
	TRN6713A	Second Oscillator
TRF1181A	TLF6482A	RF Deck
	TLF6492A	Double Doubler

TECHNICAL CHARACTERISTICS

RF Frequency Range		928-960 MHz
Channel Spacing		25 kHz
EIA Modulation Acceptance		±8 kHz minimum
Frequency		Channel element maintains receiver frequency within ±0.0002% of reference frequency from −30 °C to +60 °C ambient temperature (+25 °C reference).
Input Impedance		50 ohms
Sensitivity	20 dB Quieting	0.5 uV
	EIA Sinad	0.35 uV
Selectivity (EIA Sinad)		−80 dB @ ±25 kHz
EIA Sinad Intermodulation		−75 dB
Spurious and Image Rejection		100 dB minimum
Squelch Sensitivity Carrier Squelch (adjustable)		0.25 uV or less at threshold
Tone-Coded Squelch		0.25 uV or less
Digital-Coded Squelch		0.25 uV or less

"MICOR" "SENSITRON" RECEIVER AUDIO & SQUELCH BOARD

MODEL TRN8406A

1. DESCRIPTION

1.1 The audio and squelch board performs two basic functions -- audio amplification and audio squelching. The first two stages in the audio circuitry amplify the signal from the discriminator and provide the proper frequency response. This signal is routed to the line driver module in remote control stations and to the local logic board in local control models. The audio returns through a VOLUME control. The remaining stages in the audio circuitry take the signal returning from the line driver and VOLUME control and provide the necessary frequency response at the speaker. These latter stages also provide the driver required by the final audio amplifiers (located on a separate board) for rated power output. An integrated circuit and one transistor perform all of the above functions.

1.2 The squelch circuitry disables the audio path during intervals between received messages. One integrated circuit performs the necessary detection and squelching functions. Also, in conjunction with the PL decoder and filter board in a PL station, this integrated circuit provides unsquelching when PL signals are received.

2. FUNCTIONAL OPERATION

2.1 GENERAL

2.1.1 The audio signal from the receiver discriminator is routed to the emitter follower (refer to Figure 1.). The emitter follower output is coupled to the SQUELCH control mounted on the receiver chassis or local front panel and also to the line level potentiometer mounted on the audio & squelch board. The signal from this control is next applied to the preamplifier. If JU201 is cut, the signal is first sent through the PL filter for attenuation of the PL tone. The preamplifier output is coupled off the board to the line driver or local-logic board. Audio returning from the line driver or local-logic board is coupled through the appropriate VOLUME control to amplifier Q203. After amplification, the signal is applied to the audio amplification circuits. Here, the signal is raised to a level sufficient to drive the audio final amplifier. These are mounted on a separate board which is secured to the chassis to provide "heat-sinking" capability. The output of the audio power amplifiers is applied to an output transformer which drives a speaker or speaker desk-set transformer (local control stations only).

2.1.2 The signal returned from the SQUELCH control is applied to the squelch section for noise squelch control. Squelch action is achieved by utilizing the inherent characteristic of a discriminator known as noise quieting. An input signal will cause more quieting of noise as the signal level is increased. When a desired level of noise quieting is reached, as determined by the squelch circuitry and the setting of the SQUELCH control, the audio portion of the board and line driver are enabled to allow a message to be heard. In a remote control station, the squelch circuit disables the audio circuitry by shunting a point in the audio signal path to ground and also operating a series switch in the audio signal path of the line driver.

2.1.3 In a local control station, the series path is broken on the local-logic board. In addition, an extra shunt switch is activated on this board and its low resistance is directed back to the audio amplification circuits. This provides extremely quiet operation during periods of no signal.

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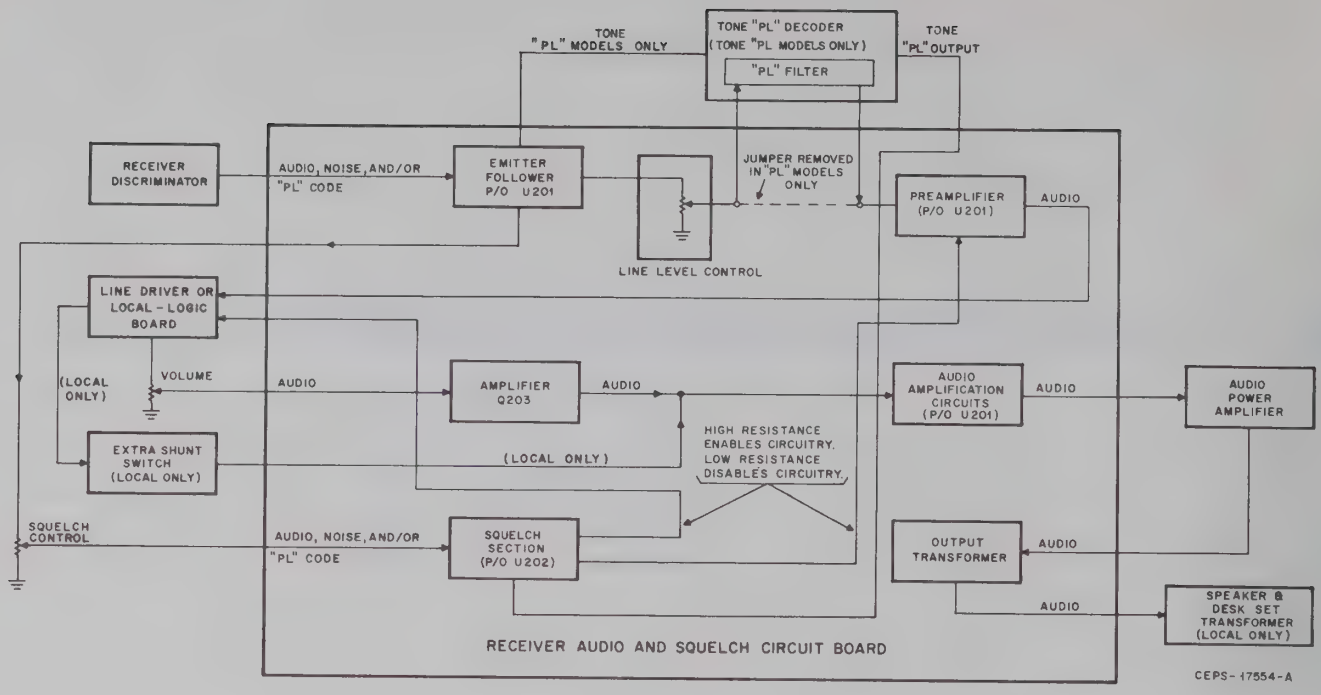


Figure 1.
Audio and Squelch Block Diagram

2.1.4 Upon completion of a received message, audio shut-off is either immediate or automatically delayed 150 milliseconds, depending upon the signal level of the previously received rf carrier. A strong signal produces the immediate shut-off and prevents an annoying, loud "squelch tail" burst from being heard. Weak signals (signals that produce less than 20 dB noise quieting) produce the long shut-off delay and prevent a message from being chopped under "flutter" conditions. Since the received signal level must be low for the long turn-off delay to occur and the "squelch tail" level is comparable to that of the received signal, the "squelch tail" is not annoying.

2.2 EMITTER FOLLOWER CIRCUIT

2.2.1 The emitter follower circuit provides a low impedance output which isolates the high impedance discriminator output from the following squelch and audio circuitry.

2.2.2 The output of the discriminator is capacitively coupled to the emitter follower input at U201-1 and may consist of noise and audio signals. The output of the emitter follower at U201-2 is routed through C207 to the SQUELCH control.

2.3 PREAMPLIFIER CIRCUIT

This circuit amplifies the low-level audio signal to provide the drive necessary for proper line driver operation. In addition, a negative feedback network (C208 and C209) provides the necessary frequency response characteristics for phone line operation. In PL stations, jumper JU202 is cut and the negative feedback is provided by C209 only. The network of R210 and C210 provides additional frequency response shaping.

2.4 AMPLIFIER CIRCUIT

Transistor Q203 increase the signal level from the line driver or local-logic board to the level required by the audio amplification circuits. Jumper JU203 is out when the equipment leaves the factory. The gain of Q203 is sufficient to drive the audio amplification circuits if the signal strength from the line driver or squelch gate exceeds -10 dBm. With a signal strength below this level, it is advisable to put in JU203 which increases the gain of Q203. The RC network at the input to this stage provides additional frequency response shaping required at the speaker.

2.5 AUDIO AMPLIFICATION CIRCUIT

2.5.1 The signal from amplifier Q203 is applied to the differential amplifier through capacitors C211 and C213. In a local station, the extra shunt switch on the local-logic board is connected to the junction of C211 and C213.

2.5.2 The differential amplifier output provides the drive for the complementary amplifier. Resistors R221 and R220 form a voltage divider biasing the differential amplifier at one-half of the supply voltage. Undesirable transient voltages are eliminated by capacitor C212.

2.5.3 Final audio amplification on the audio and squelch board occurs in the complementary amplifier. These stages provide the drive for the audio power amplifiers which are mounted on a separate board. The complementary amplifier emitter resistors (R218 and R219) are not included in U201 because of their high heat dissipation requirements.

2.5.4 Audio returned to the audio and squelch board (from the audio power amplifier transistors) is applied to the output transformer primary windings. This transformer consists of four windings -- two input primaries, an output secondary, and a feedback secondary. The output secondary winding couples audio power to an external 8-ohm speaker which can be driven with up to 10 watts at less than 5% distortion. Negative feedback from the output transformer winding through C216 and across R211 gives 6 dB per octave de-emphasis (roll-off) to the audio which has been pre-emphasized 6 dB per octave in the transmitter. Below 300 Hz, feedback from R213 and across C215 increases giving low frequency de-emphasis. Capacitor C238 rolls off the high frequency gain of the amplifier to prevent high frequency oscillation. Capacitors C223 and C224, C240, C241, and C242 are rf bypass capacitors that shunt stray rf on the audio A+ and audio A- lines to ground. In local operation the output secondary winding couples audio power to a 16-ohm speaker and an autotransformer. This transformer will drive up to six local desk sets.

2.6 NOISE ACTIVATED SQUELCH CIRCUIT

2.6.1 Squelch Input Circuit

2.6.1.1 The input signal from the SQUELCH control may consist of audio and noise. An input shaping network precedes U202 and passes high frequencies while attenuating low frequencies. Allowing the high frequencies to pass eliminates the effect of voice and results in more sensitive threshold squelch action.

2.6.1.2 The first amplifier and limiter is driven into limit by its input signal and prevents audio from squelching (disabling) the audio channel on voice signals. Amplified, limited noise is then passed through a coupling network to the second amplifier. This coupling network is also a high pass filter which further attenuates voice and tone signals to the second amplifier.

2.6.1.3 The second amplifier amplifies the noise signal and applies it through an RC coupling network to the detector. Capacitor C233 and C234 form another high pass filter that attenuates the low frequencies. Capacitor C234 is used to produce a peak-to-peak detector action from the noise detector, and thus, generate twice the output voltage of a peak detector. This capacitor does not affect frequency response.

2.6.2 Detector and Switching Circuits

2.6.2.1 The detector output level is a function of received signal strength and the setting of the SQUELCH control. The detector develops the dc output voltage across filter capacitor C235. The lowest dc output voltage corresponds to a no signal input (maximum noise) condition. The output voltage increases as the received rf carrier signal level increases (noise decreases).

2.6.2.2 The primary function of the detector output, however, is the control of shunt switching. This is done by applying the detector output to three squelch control circuits simultaneously:

-- long "squelch-tail" circuit

-- long "squelch-tail" defeat switch

-- carrier squelch switching logic

2.6.2.3 With no received rf carrier signal (maximum noise condition), the long "squelch tail" circuit and long "squelch tail" defeat switch are "off" and the carrier squelch switching logic is "on". The audio channel is subsequently disabled unless the squelch control logic is overridden by other circuitry.

2.6.2.4 As the input signal level increases (noise decreases), the detector output voltage increases. A detector output voltage above 2.8 volts dc results in enabling of the long "squelch tail" circuit. The long "squelch tail" circuit produces a voltage at U202-12 of 5.5 volts dc; this voltage causes the carrier squelch switching logic circuit to turn "off" and thereby enables the audio channel. Capacitor C236 and resistor R235 provide a rapid-rise, slow-decay time constant to the voltage applied to the carrier squelch switching logic circuit. This permits a weak signal to immediately enable the audio channel, yet delays the audio channel shut-off if the signal is in a "flutter" condition. The voltage necessary to enable the carrier squelch switching logic is approximately 3.8 volts dc.

2.6.2.5 A voltage greater than 5 volts dc at the detector output (rf carrier signal level that produces 20 dB quieting or better with the SQUELCH control set at threshold), turns on the long "squelch tail" defeat switch. This disables the long "squelch tail" circuit and the 150 millisecond delay function. Audio channel disabling now occurs immediately after the rf carrier disappears.

2.6.3 Squelch Output Circuit

The squelch control logic circuit directly controls the shunt switches.

2.6.3.1 The output of the squelch control logic circuit depends upon the output of the preceding carrier squelch switching logic circuit. With the carrier squelch switching logic circuit "off", the squelch control logic circuit will turn off the shunt switches, allowing a message to be heard. If the carrier squelch switching logic is "on", the squelch control logic circuit will turn on the shunt switches, disabling the audio channel, and activating the series switches in the line driver or local-logic board. Capacitor C237, connected to U202-10, slows the turn-off of the shunt switches to "soften" what would otherwise be an annoyingly abrupt turn-on of the audio. This same point (U202-10) supplies a digital output voltage that can be used as an indicator that the receiver is unsquelched (audio channel enabled).

2.6.3.2 Two additional functions that may affect the squelch control logic output are associated with "Private-Line" operation. PL disable (U202-14) may be either shorted to ground or open. When an open is present at U202-14 (PL disabled), a received signal with or without a PL code will be heard from the speaker. When at ground potential (PL enabled), the output of the carrier squelch switching logic circuit is inhibited. When the proper PL code is received, a positive 9.5 volts dc from the PL decoder board to U202-8 turns off the squelch control logic circuit which turns off the shunt switches and allows a message to be heard. Jumper JU204 is normally in the circuit and is only cut when a field modification is made. The cutting of this jumper and associated modifications on the receiver interconnect board will provide "AND-SQUELCH" operation, changing the PL squelch circuitry from fixed sensitivity operation to variable sensitivity operation. Under this mode of operation, the SQUELCH control will affect the squelch sensitivity.

2.6.3.3 Audio disabling is performed by shunting the audio circuit to ground through a low impedance path and also by the operation of a series switch in the line driver or local-logic board. When the solid state shunt switch is turned "on" (U202-7), signals developed across R236 are shunted to ground. This prevents any signals from being heard at the speaker. Acting in tandem with the first shunt switch, the second shunt switch output is routed to the line driver or local-logic board and enables a set of switches on either of the boards. In a remote control system, this breaks the audio path and prevents audio from appearing on the 600-ohm line. In a local control system, these series switches also break the audio path, thus preventing any audio or hum and noise from reaching the speaker.

3. MAINTENANCE

3.1 GENERAL

This section of the manual provides maintenance shop type procedures for the audio and squelch board. It assumes that preliminary tests have already localized the trouble to this board. These bench tests include procedures for testing and troubleshooting, including integrated circuit check-out.

NOTE

The audio and squelch board must be installed in a station for testing to provide the necessary power and ground connections.

3.2 PERFORMANCE TESTS

The performance tests may be used for troubleshooting to isolate the point of abnormal operation. They may also be used after repair to assure that the board is operating properly before it is returned to service.

3.2.1 Audio Amplification

3.2.1.1 Specifications

The audio section of the audio and squelch board combined with the separate audio power amplifier transistors will provide at least 10-watts (5 watts local) audio output at less than 5 per cent distortion from a 3.0 kHz deviated, 1 kHz modulated on-frequency signal applied to the station antenna receptacle.

3.2.1.2 Procedure

Step 1. Replace the speaker with an 8-ohm, 15-watt non-inductive resistor. In local control stations, disconnect the autotransformer.

Step 2. Set the SQUELCH control fully counter-clockwise (unsquelched). "Private-Line" stations must also be PL disabled.

Step 3. Connect an rf signal generator to the station antenna receptacle and adjust it to the receiver frequency.

Step 4. Adjust the signal generator for 1000-microvolt output, modulated with 1000-Hz tone at ±5.0 kHz deviation.

Step 5. Connect an AC voltmeter to pin J903-7 at the receiver interconnect board.

Step 6. Adjust the line level control R203 for 175 mV ac rms.

Step 7. Reduce the deviation to ±3.0 kHz.

Step 8. Connect an AC voltmeter across the 8-ohm resistor.

Step 9. Adjust the VOLUME control until 9.0 volts ac rms is read on the ac voltmeter (this represents 10 watts).

Step 10. Measure distortion at 10-watts audio power output. It should be less than 5 per cent.

3.2.2 Squelch Control

3.2.2.1 Specifications

3.2.2.1.1 The squelch section of the receiver audio and squelch board shall enable the audio section when an rf signal level greater than 6 dB noise quieting (one-half the discriminator output level with no signal input) is applied to the receiver with the SQUELCH control set at threshold. When the signal is removed from the station, the audio channel shall become disabled after approximately 150 milliseconds. When an input signal greater than that required for approximately 20 dB noise quieting is removed from the station, the audio channel shall become disabled immediately.

3.2.2.1.2 When the SQUELCH control is turned fully clockwise (tight squelch) an input signal that produces about 20 dB noise quieting shall be required to enable the audio channel.

3.2.2.1.3 The squelch section shall inhibit audio output when no input signal is received.

3.2.2.1.4 In "Private-Line" stations, the squelch section of the receiver's audio and squelch board shall perform as described in paragraphs 3.2.2.1.1, .2, and .3 while the radio set is PL disabled.

3.2.2.1.5 In PL operation, the squelch section shall inhibit audio output when the proper PL code is not received, regardless of the input signal strength.

3.2.2.2 Procedure

3.2.2.2.1 Carrier Squelch Stations

Step 1. Turn the station on and adjust the SQUELCH control clockwise from the full counterclockwise position until the receiver just quiets (threshold squelch).

Step 2. Measure the resistance of U202-6 and -7 with reference to ground. Both pins should be less than 1000 ohms.

NOTE

Erroneous readings will be obtained in resistance measurements if the voltage between the ohmmeter probes exceeds approximately 5.0 volts dc.

Step 3. Connect a signal generator to the station antenna receptacle and adjust it to the receiver frequency. Modulate the generator output with a 1000-Hz tone at ±3.0 kHz deviation.

Step 4. Increase the signal generator output slowly until the receiver just unsquelches. Remove the modulation from the signal generator. Unsquelching should occur at a generator output that produces 6 dB noise quieting, or less.

Step 5. Measure the resistances of U202-6 and -7 with reference to ground. Both pins should be greater than 200,000 ohms.

Step 6. Increase the signal generator output until approximately 12 dB noise quieting is obtained. Remove the rf signal from the station input either by turning off the signal generator or by using a relay in series with the signal generator output. A long "squelch tail" should occur. If a calibrated, triggered sweep oscilloscope is available for measurement, the duration of the "squelch tail" should be approximately 150 milliseconds as measured at the speaker.

Step 7. Increase the signal generator output to produce 30 dB noise quieting. Turn off the rf signal and note the "squelch tail" duration. It should be no more than a "click". The duration should be less than 10 milliseconds.

Step 8. Turn the SQUELCH control fully clockwise (tight squelch).

Step 9. Adjust the signal generator output level until the station just unsquelches. Unsquelching should occur at a generator output that produces approximately 20 dB noise quieting.

3.2.2.2.2 "Private-Line" Stations

Step 1. Disable the PL circuitry.

Step 2. Perform perviously described carrier squelch station procedure.

Step 3. Return the station to PL operation. On stations using "AND" squelch operation, also turn the SQUELCH control fully counterclockwise during this test.

Step 4. Vary generator output between minimum output and 1000 microvolt output while checking the resistances of U202-6 and -7 with reference to ground. Both resistances should remain at less than 1000 ohms.

Step 5. Modulate the on-frequency generator output with a PL code for ±0.5 to ±1 kHz deviation and 1000 Hz tone for ±3.0 kHz overall deviation.

Step 6. Increase the signal generator output slowly until the receiver just unsquelches. Unsquelching should occur at a generator output that produces 6 dB quieting or less, for "PL" stations. For "DPL" stations, unsquelching should occur at a generator output that produces 8 dB quieting or less.

3.3 TROUBLESHOOTING

3.3.1 Check Input Voltages

A malfunction in the audio and squelch operation may be due to the loss of dc input voltages which can be caused by this board or another section of the station. Since there are only two input voltages applied to this board, it is advantageous to verify their presence before beginning extensive troubleshooting.

P903-1, -4	+9.6 V dc in respect to chassis
P903-16	Audio A+ (approximately +13.6 V dc in respect to A-)

In a negative ground system, audio A- is at chassis potential. In a positive ground system, audio A+ is at chassis potential.

3.3.2 Isolating Defective Components

If tests indicate abnormal performance, a logical troubleshooting procedure should be followed to isolate the defective component efficiently. Results of performance tests usually localize the malfunction to one or two stages. The accompanying troubleshooting chart summarizes these results in a logical sequence. A few waveforms, voltage and resistance checks in the suspected circuit should readily isolate the defective component when compared with those on the schematic diagram.

3.3.3 Troubleshooting Integrated Circuits

Integrated circuits (IC's) are very reliable components and should not be replaced until all checks have proven definitely that the IC is the defective component. Make sure that the external components in the circuit are normal. The IC's on the audio and squelch board may be checked by dc voltage measurements although signal tracing with an oscilloscope is preferred.

3.3.4 Stage Gain Measurements

3.3.4.1 Squelch Circuitry

3.3.4.1.1 This troubleshooting procedure may be used to isolate a squelch malfunction occuring before the detector to a specific stage. The test is performed by injecting an ac signal at the input to the squelch circuitry and

noting results obtained with an ac voltmeter. Most accurate results are obtained by taking dB gain and loss measurements between points as illustrated in Figure 2. Individual point voltage checks may also be used to quickly verify proper squelch input circuitry operation but this is not an adequate test to prove the circuit is defective (refer to the following table and Figure 2). Tolerance addition may cause increasing variation from the typical readings in the table as readings are taken further from the injected signal point.

3.3.4.1.2 The following procedure may be used for loss and gain or signal level measurements while injecting a 3 kHz or 30 kHz signal. In "Private-Line" radios, PL operation will not affect this test.

Step 1. Turn the VOLUME control fully counter-clockwise (off), or to a comfortable listening level, if desired.

Step 2. Turn the SQUELCH control fully clockwire (squelched) and turn the station on.

Step 3. Inject a 1000-microvolt, on-channel signal at the station antenna receptacle. This "quiets" the discriminator output and prevents erroneous test readings.

Step 4. Inject a 3 kHz, 10 millivolt rms signal at the receiver audio & squelch board at P903-9.

Step 5. Take loss and gain measurements or signal level measurements as required.

Step 6. Repeat the preceding test using a 30 kHz signal in place of the 3 kHz signal in step 4.

3.3.4.2 Audio Circuitry

AC voltage measurements and waveforms are given where applicable on the schematic diagram. Refer to this diagram for pertinent information when taking audio stage gain measurements.

AC VOLTMETER CONNECTED TO U202-PIN	AC VOLTMETER READING WITH 3 kHz SIGNAL INPUT (mV)	AC VOLTMETER READING WITH 30 kHz SIGNAL INPUT (mV)
15	2.2	6.3
1	25	70.8
2	1.4	11.2
3	16	126
4	2.8	112

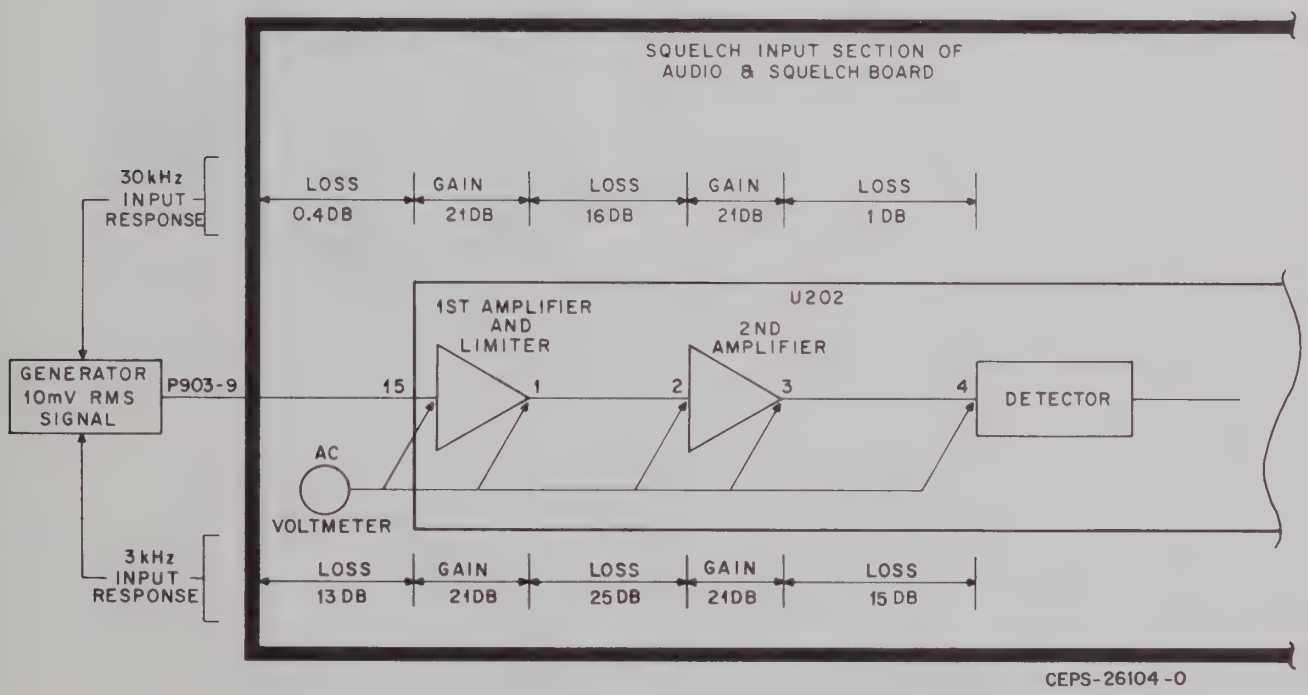
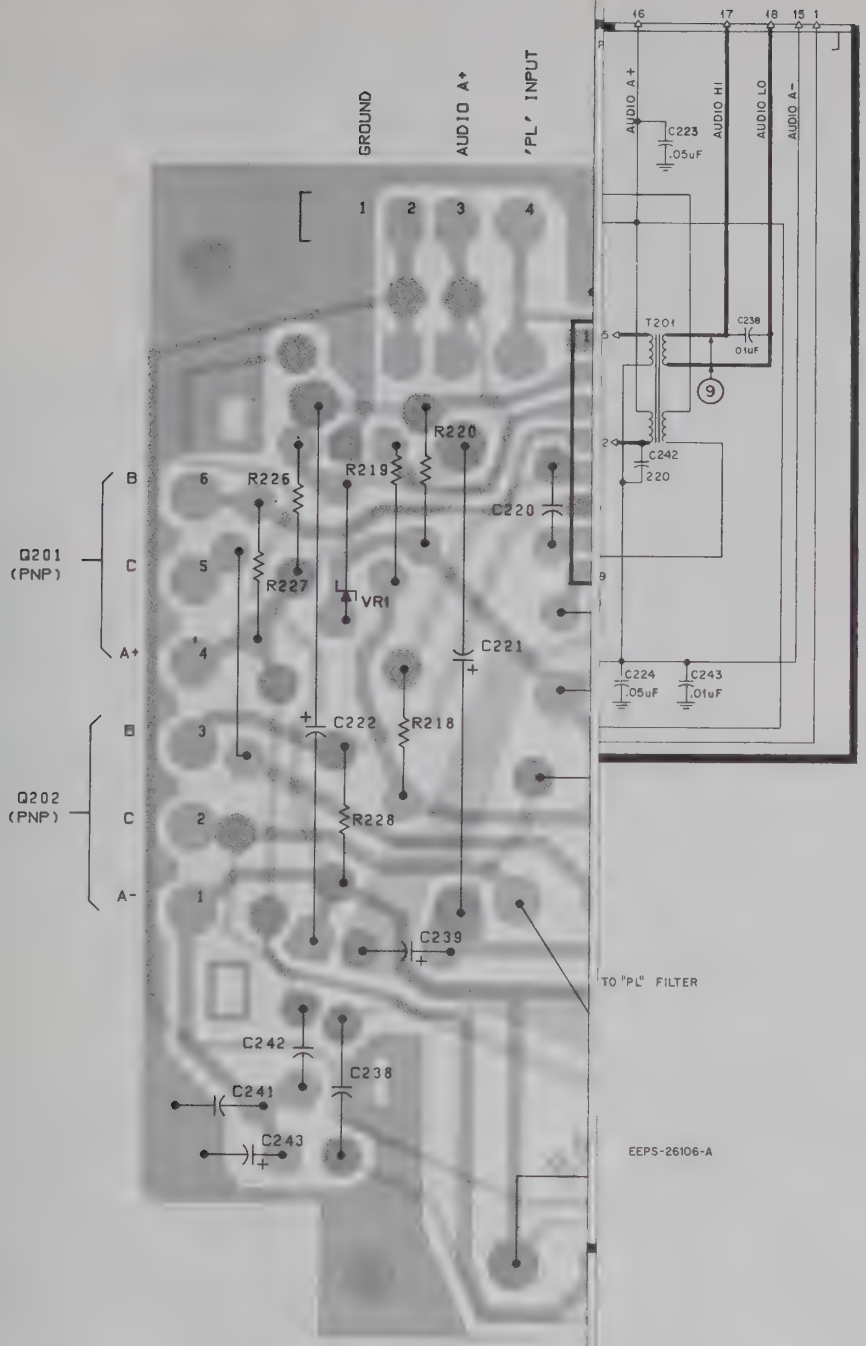


Figure 2.
Squelch Circuitry Stage Gain Measurements



NOTES

201. +5.6 VOLTS WHEN THRESHOLD SIGNAL JUST OPENS SQUELCH (I.E., APPROXIMATELY 6 dB QUIETING SIGNAL WITH SQUELCH CONTROL AT THRESHOLD).
202. WHERE MORE THAN ONE VOLTAGE READING APPEARS:
USQ= RECEIVER UNSQUELCHED
FSQ= RECEIVER FULLY SQUELCHED
203. VOLTAGE MEASURED WITH RESPECT TO A-.
204. VOLTAGE MEASURED WITH RESPECT TO A+.
205. VOLTAGES AT U201-6 AND -7 MUST BE THE SAME VALUE.
206. UNLESS OTHERWISE STATED:
CAPACITOR VALUES ARE IN PICOFARADS.
207. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES ±10% MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND.
208. AUDIO POWER AMPLIFIER IS NOT PART OF AUDIO & SQUELCH BOARD
209. JUMPER JU204 MUST BE REMOVED FOR "AND SQUELCH" OPERATION. (SEE "RECEIVER INTERCONNECT UNIT" SECTION). SEE JUMPER TABLE FOR JUMPER USE.

210 RED-- WHITE WIRE CONNECTS TO C211-C213 JUNCTION IN ALL LOCAL CONTROL STATIONS AND IN LOCAL/REMOTE STATIONS WITH INTER-COM. IN ALL OTHER MODELS THE RED-- WHITE WIRE CONNECTS TO P903-1L

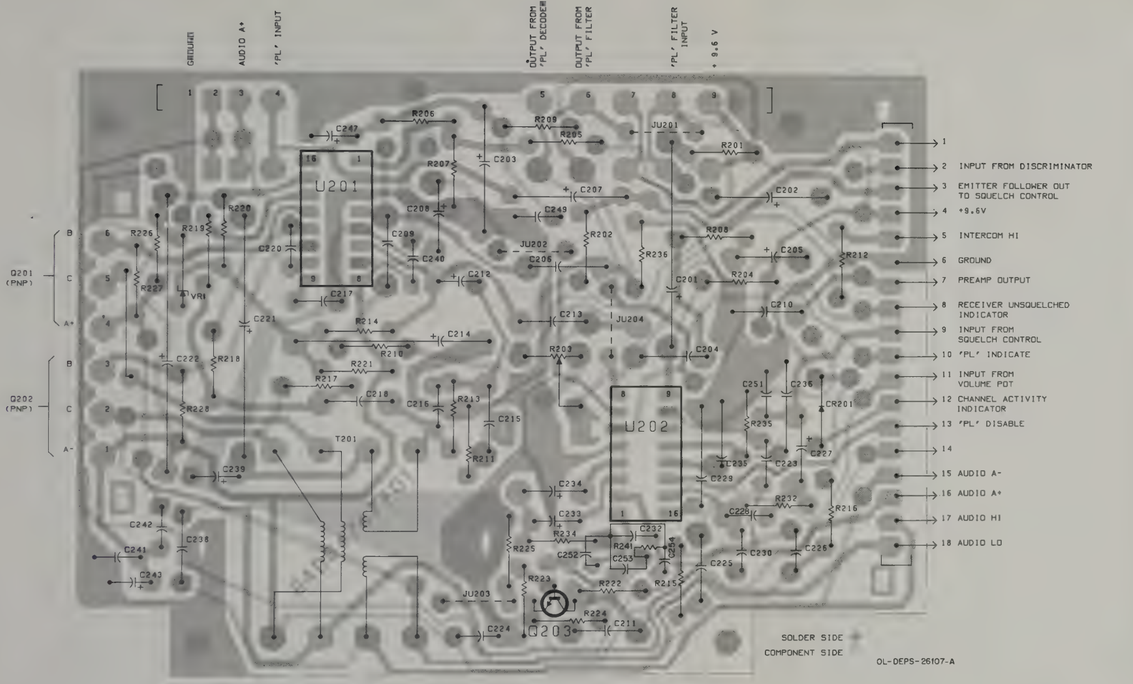
JUMPER TABLE

JUMPER	
JU201	CONNECTED IN CARRIER SQUELCH STATIONS AND "DIGITAL PRIVATE LINE" STATIONS
JU202	CONNECTED IN CARRIER SQUELCH STATIONS AND "DIGITAL PRIVATE LINE" STATIONS.
JU203	CONNECTED TO PROVIDE 10 WATTS AUDIO AT SPEAKER WITH LINE LEVELS OF -10dBM OR LESS (REMOTE CONTROL STATIONS ONLY).
JU204	CUT FOR "AND SQUELCH"

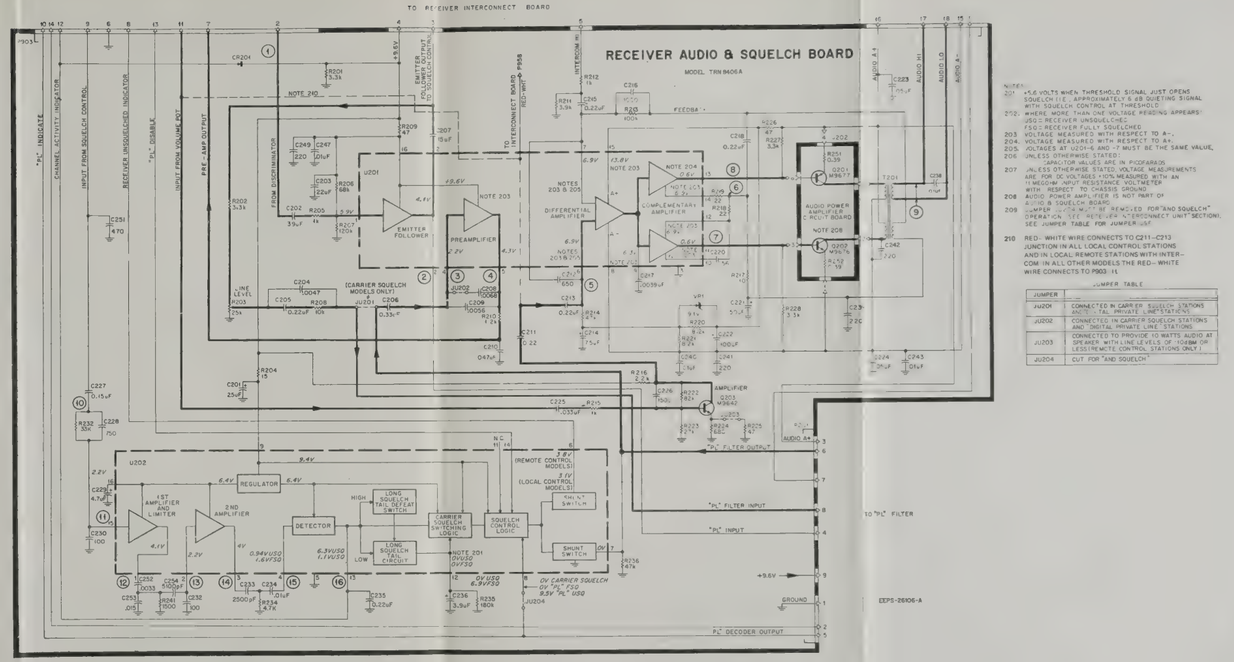
RECEIVER AUDIO & SQUELCH BOARD

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

TRN8406A Audio and Squelch Board
Schematic Diagram, Circuit Board Detail,
and Troubleshooting Chart
Motorola No. PEPS-26108-A
(Sheet 1 of 2)
9/1/80-UP



SHOWN FROM SOLDER SIDE



NOTES:
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202 VOLTAGE MEASURED WITH RESPECT TO A-.
203 VOLTAGE MEASURED WITH RESPECT TO A+.
204 VOLTAGES AT VOD=6 AND 7 MUST BE THE SAME VALUE.
205 UNLESS OTHERWISE STATED:
CAPACITOR VALUES ARE IN MICROFARADS
206 UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE DC VOLTAGES ±10% MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND
207 AUDIO POWER AMPLIFIER IS NOT PART OF AUDIO & SQUELCH BOARD.
208 JUMPER JU204 "HI" REMOVED FOR "2 TONE SQUELCH" OPERATION. SEE INTERFACE INTERCONNECT UNIT SECTION. SEE JUMPER TABLE FOR JUMPER USE.
209 RED- WHITE WIRE CONNECTS TO C211-C213 JUNCTION IN ALL LOCAL CONTROL STATIONS AND IN LOCAL/REMOTE STATIONS WITH INTERCOM IN ALL OTHER MODELS THE RED- WHITE WIRE CONNECTS TO P903 :1L

JUMPER TABLE

JUMPER	
JU20X	CONNECTED IN CARRIER SQUELCH STATIONS AND DIGITAL PRIVATE LINE STATIONS
JU202	CONNECTED IN CARRIER SQUELCH STATIONS AND DIGITAL PRIVATE LINE STATIONS
JU203	CONNECTED TO PROVIDE 10 WATTS AUDIO AT SPEAKER WITH LINE LEVELS OF -10dBM OR LESS (REMOTE CONTROL STATIONS ONLY)
JU204	CUT FOR 2 AND SQUELCH

ALL SQUELCH CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY = 0.5 V/DIV.
2. HORIZONTAL DEFLECTION = 2 msec/DIV.
3. SQUELCH CONTROL FULLY CLOCKWISE (ON). NO EXTERNAL SIGNAL APPLIED.
*4. WAVEFORMS ⑮ AND ⑯ ARE DC COUPLED WITH ZERO AT BOTTOM, OTHERS AC COUPLED.

EPS-6534-O

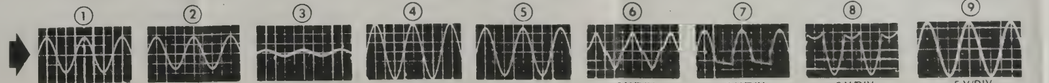
SQUELCH CIRCUIT WAVEFORMS

ALL AUDIO CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER THE FOLLOWING CONDITIONS

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM
2. HORIZONTAL DEFLECTION = .25 msec/DIV
3. SQUELCH CONTROL FULLY COUNTERCLOCK WISE (OFF). 1000 uV RF SIGNAL INPUT MODULATED WITH 1000 Hz TONE WITH ±3.0 kHz DEVIATION
4. VOLUME CONTROL SET FOR 9.0 V rms AT LOAD
5. OUTPUT TERMINATED IN 8 OHM LOAD
6. R203 SET FOR 175 mV AT PIN 7 WITH ±5 kHz DEVIATION (1 kHz TONE)

EPS-8804-O

AUDIO CIRCUIT WAVEFORMS



PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TRN8406A Audio and Squelch Board
Schematic Diagram, Circuit Board Detail, and Troubleshooting Chart
Motorola No. PEPS-26108-A
(Sheet 1 of 2)
9/1/80-UP

PARTS LIST

TRN8406A Audio and Squelch Board — PL-5930-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed; uF; ±10%; 100 V; unl. stated
C201	23-83210A01	25 +150-10%; 25 V
C202	23-82783B36	39; 10 V
C203	23-84762H10	22 ±20%; 15 V
C204	8-83813H12	.0047
C205	8-83813H11	0.22; 75 V
C206	8-83813H29	0.33; 50 V
C207	23-82783B24	15; 25 V
C208	8-83813H01	.0068
C209	8-83813H26	.0056 ±5%; 50 V
C210	8-82905G03	.047; 50 V
C211	8-83813H11	0.22; 75 V
C212	21-848236	650 pF ±5%; 500 V
C213	8-83813H11	0.22; 75 V
C214	23-84081B03	75 +150-10%; 15 V
C215	8-83813H11	0.22; 75 V
C216	21-82187B20	1000 pF
C217	21-82187B43	.0039; 200 V
C218	8-83813H11	0.22; 75 V
C219		NOT USED
C220	21-83406D46	56 pF ±5%; 500 V; N150
C221	23-84081B01	50 +100-10%; 25 V
C222	23-83210A08	100 +150-10%; 25 V
C223, 224	21-82372C04	.05 +80-20%; 25 V
C225	8-82905G16	.033
C226	21-82187B31	1500 pF ±10%; 100 V
C227	8-83813H07	0.15; 75 V
C228	21-84494B22	750 pF ±5%
C229	23-84762H07	4.7 ±20%; 10 V
C230	21-84426B06	100 pF ±5%; 500 V
C231		NOT USED
C232	21-82133G03	100 pF ±5%; 500 V; N750
C233	21-863296	2500 pF ±2%
C234	8-83813H31	.01; 100 V
C235	8-83813H11	0.22; 75 V
C236	23-84762H08	3.9 ±20%; 15 V
C238	21-82372C01	0.1 +80-20%; 25 V
C239	21-83596E10	220 pF ±20%; 500 V
C240	21-832501	.01 +60-40%; 250 V
C241, 242	21-83596E10	220 pF ±20%; 500 V
C243	21-832501	.01 +60-40%; 250 V
C244		NOT USED
C245, 246		NOT USED
C247	21-832501	.01 +60-40%; 250 V
C249	21-83596E10	220 pF ±20%; 500 V
C251	21-84426B11	470 pF ±5%; 500 V
C252	8-82905G25	.0033
C253	8-82905G15	.015
C254	21-874354	5100 pF ±5%
		DIODE: (SEE NOTE)
CR201	48-83654H01	silicon
		CONNECTOR, plug:
P201		consists of contact pins mounted on circuit board
		TRANSISTOR: (SEE NOTE)
Q203	48-869642	NPN: type M9642
		RESISTOR, fixed: ±5%; 1/4 W; unl. stated
R201, 202	6-124A61	3.3k
R203	18-83083G24	variable: 25k ±30%
R204	6-124A05	15
R205	6-124A49	1k
R206	6-124A93	68k
R207	6-124A99	120k
R208	6-124A73	10k
R209	6-124A17	47 ±10%
R210	6-124A51	1.2k
R211	6-124A63	3.9k
R212	6-124A49	1k
R213	6-124A97	100k
R214	6-124A89	47k
R215	6-124A49	1k
R216	6-124A57	2.2k
R217	6-124A01	10
R218, 219	6-124A09	22
R220, 221	6-124A71	8.2k
R222	6-124A95	82k
R224	6-124A45	680
R225, 226	6-124A17	47
R227, 228	6-124A61	3.3k
R229 thru 231		NOT USED
R232	6-124A85	33k
R233		NOT USED
R234	6-124A65	4.7k
R235	6-124B04	180k ±10%
R236	6-124A89	47k ±10%
R240		NOT USED
R241	6-124A53	1.5k
		TRANSFORMER, AF:
T201	25-84083B02	pri: split winding; total res 0.5 Ohms max sec: res 0.8 Ohms max feedback: res 2 Ohms max
		INTEGRATED CIRCUIT: (SEE NOTE)
U201	51-82848M70	type M4870
U202	51-84267A09	type SC6709
		DIODE: (SEE NOTE)
VR1	48-82256C38	Zener; 9.1 V; 400 mW
		NON-REFERENCED ITEMS
	42-84284B01	RETAINER; 4 req'd.
	3-138162	SCREW, tapping: Phillips rd. hd., 4-40 x 3/8"; 4 req'd. (used for mounting Retainers)
	55-84300B01	HANDLE (long)
	55-84300B02	HANDLE (short)
	29-84028H01	TERMINAL, contact; 18 req'd. (long)
	29-84028H02	TERMINAL, contact; 24 req'd. (short)

NOTE: Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

MOTOROLA INC.
Communications
Group

AUDIO POWER AMPLIFIER

MODEL TLN4290B

1. DESCRIPTION

The audio power amplifier provides the required power to drive an 8-ohm speaker with 10 watts of audio power, or a 16-ohm speaker with 5 watts of audio power, with less than 5% overall distortion. Two complementary power transistors (NPN and PNP types), operating class AB, with two current limiting resistors, develop this power. The audio drive from the audio and squelch board is routed to this board, amplified, and then returned to the audio and squelch board, where it is applied to the audio output transformer.

The aluminum transistor mounting plate is anodized with a thin, very tough material. This mounting plate provides excellent electrical insulation and thermal conduction properties between the transistors and the heatsink.

2. SERVICING

a. Performance Checks

Performance checks on this board consists of taking resistance readings as is done for any transistor or resistor. It should be noted, however, that many VTVM's and solid-state multimeters do not have sufficient voltage at the test probes to forward bias a transistor junction into conduction and, therefore, should not be used. An inexpensive volt-ohm meter of 1,000 to 20,000 ohms-per-volt sensitivity is sufficient for performing these checks.

NOTE

Do not insert meter test probe tips into female connectors on the board. To do so could cause damage to the connectors and result in poor electrical interconnection with the audio and squelch board.

b. Transistor Replacement

Care must be exercised to prevent damage (such as a scratch) to the mounting plate anodizing at the transistor-mounting plate interface. Should the anodizing in this area become scratched, original performance can only be restored by the use of a new anodized plate. The plate can *not* be "repaired" by the use of any type of insulating washer without a loss in thermal conduction capability.

Factory replacement transistors are supplied with pre-formed leads to properly fit onto the aluminum mounting plate and circuit board. A new nylon shoulder washer is also included.

Step 1. Apply a thin, even coat of silicon grease to the metallic area of the transistor.

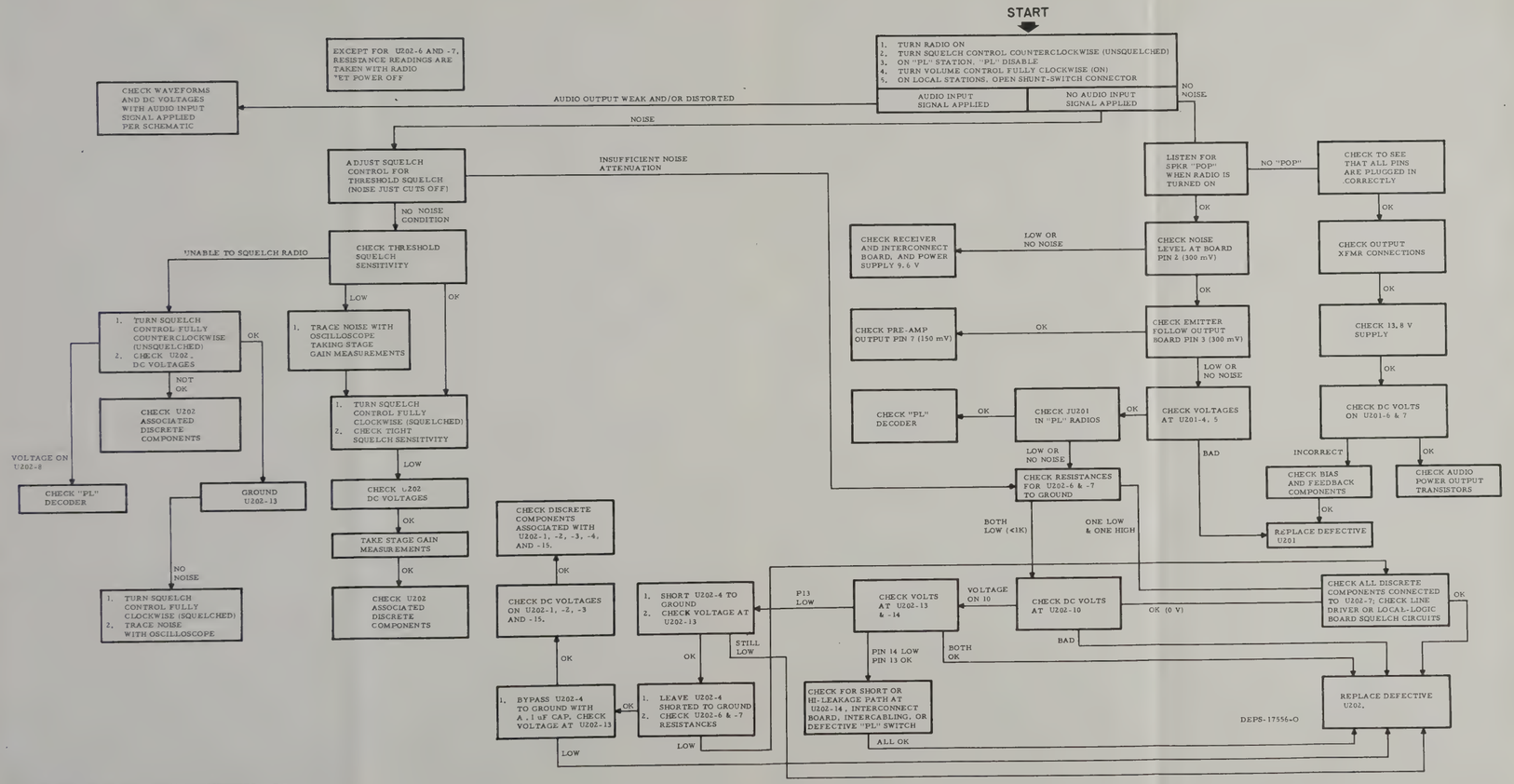
Step 2. Mount the transistor using the *new* nylon shoulder washer. Do not solder leads at this time. Tighten the transistor mounting screw.

Step 3. Solder transistor leads to printed circuit board.

TRANSISTOR RESISTANCE MEASUREMENT CHECK
(BOARD REMOVED FROM RADIO — TRANSISTORS MOUNTED ON BOARD)

Ohmmeter Connections		Proper Resistance	
Positive Lead Connected to	**Negative Lead Connected to**	**P-N-P Transistor**	**N-P-N Transistor**
Base	Emmitter, then Collector	Infinite	5-30 Ohms, Both Cases
Emmitter, then Collector	Base	5-30 Ohms, Both Cases	Infinite
Collector	Emitter	Infinite	Infinite
Emitter	Collector	Infinite	Infinite

Failure to obtain these results indicates a defective transistor which must be replaced.



TRN8406A Audio and Squelch Board
Schematic Diagram, Circuit Board Detail
and Troubleshooting Chart
Motorola No. PEPS-26108-A
(Sheet 2 of 2)
9/1/80-UP

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C207	23-82783B24	15; 25 V
C208	8-83813H01	.0068
C209	8-83813H26	.005o ±5%; 50 V
C210	8-82905C03	0.47; 20 V
C211	8-83813H11	0.22; 75 V
C212	21-848236	o50 pF ±5%; 500 V
C213	8-83813H11	0.22; 75 V
C214	23-84081B03	75 +150-10%; 15 V
C215	8-83813H11	0.22; 75 V
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C217	21-82187B43	.0039; 200 V
C218	8-83813H11	0.22; 75 V
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C240	21-832501	.01 +60-40%; 250 V
C241, 242	21-83596E10	220 pF ±20%; 500 V
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C244		NOT USED
C245, 246		NOT USED
C247	21-832501	.01 +60-40%; 250 V
C249	21-83596E10	220 pF ±20%; 500 V
C251	21-84426B11	470 pF ±5%; 500 V
C252	8-82905G25	.0033
C253	8-82905G15	.015
C254	21-874354	5100 pF ±5%
CR201	48-83654H01	DIODE: (SEE NOTE) silicon
P201		CONNECTOR, plug: consists of contact pins mounted on circuit board
Q203	48-869642	TRANSISTOR: (SEE NOTE) NPN; type M9642
R201, 202	6-124A61	RESISTOR, fixed: ±5%; 1/4 W; unl. stated 3.3k
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R240		NOT USED
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U202	51-842o7A09	type SC6709
VR1	48-82256C38	DIODE: (SEE NOTE Zener; 9.1 V; 400 mW
		NON-REFERENCED ITEMS
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	3-1381o2	SCREW, tapping: Phillips rd. hd., 4-40 x 3/8; 4 req'd. (used for mounting Retainers)
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Performance checks on this board consists of taking resistance readings as is done for any transistor or resistor. It should be noted, however, that many VTVM's and solid-state multimeters do not have sufficient voltage at the test probes to forward bias a transistor junction into conduction and, therefore, should not be used. An inexpensive volt-ohm meter of 1,000 to 20,000 ohms-per-volt sensitivity is sufficient for performing these checks.

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b. Transistor Replacement

Care must be exercised to prevent damage (such as a scratch) to the mounting plate anodizing at the transistor-mounting plate interface. Should the anodizing in this area become scratched, original performance can only be restored by the use of a new anodized plate. The plate can *not* be "repaired" by the use of any type of insulating washer without a loss in thermal conduction capability.

Factory replacement transistors are supplied with pre-formed leads to properly fit onto the aluminum mounting plate and circuit board. A new nylon shoulder washer is also included.

Step 1. Apply a thin, even coat of silicon grease to the metallic area of the transistor.

Step 2. Mount the transistor using the *new* nylon shoulder washer. Do not solder leads at this time. Tighten the transistor mounting screw.

Step 3. Solder transistor leads to printed circuit board.

TRANSISTOR RESISTANCE MEASUREMENT CHECK
(BOARD REMOVED FROM RADIO — TRANSISTORS MOUNTED ON BOARD)

Ohmmeter Connections		Proper Resistance	
Positive Lead Connected to	**Negative Lead Connected to**	**P-N-P Transistor**	**N-P-N Transistor**
Base	Emmitter, then Collector	Infinite	5-30 Ohms, Both Cases
Emmitter, then Collector	Base	5-30 Ohms, Both Cases	Infinite
Collector	Emitter	Infinite	Infinite
Emitter	Collector	Infinite	Infinite

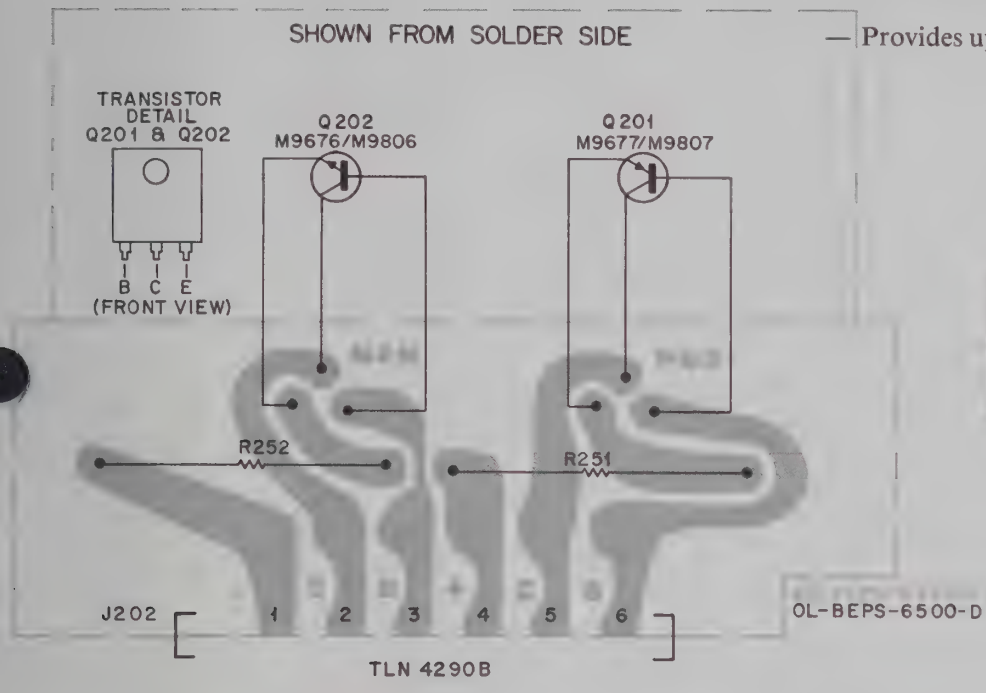
Failure to obtain these results indicates a defective transistor which must be replaced.

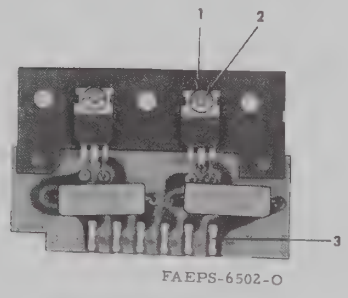
AUDIO POWER AMPLIFIER

MODEL TLN4290B

FUNCTION

— Provides up to 10 watts audio output.





REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

AUDIO POWER AMPLIFIER

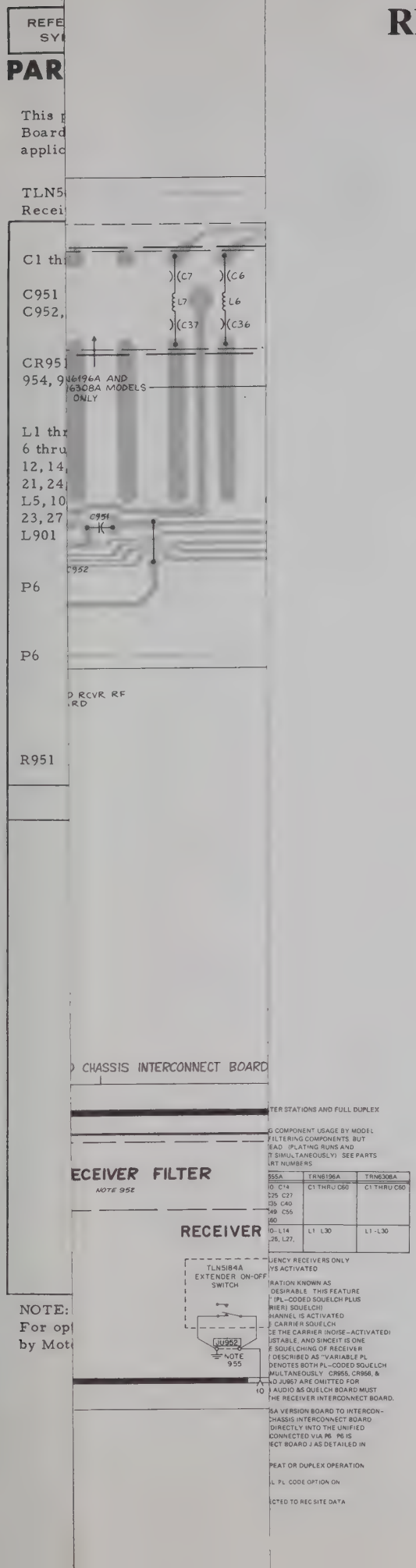
TLN4290B Audio Power Amplifier PL-1061-D

J202		CONNECTOR, receptacle: c/o; 9B83011H01 PIN, female; 6 req'd
		TRANSISTOR: (SEE NOTE)
Q201	48R869807	PNP; type M9807
	or48R869677	PNP; type M9677
Q202	48R869806	NPN; type M9806
	or48R869676	NPN type M9676
		RESISTOR, fixed: ±10%; 3 W:
R251	17D82177B49	0.39
R252	17D82177B49	0.39
MECHANICAL PARTS		
1	4B84180C01	WASHER, shoulder
2	3S129841	SCREW, machine: No. 4-40 x 1/4"; incl. lockwasher
3	9B83011H01	PIN, female

RECEIVER INTERCONNECT BOARD

FUNCTION

Interconnects various receiver circuit boards to the unified chassis interconnect board. Model differences are primarily rf filtering.



Receiver Interconnect Board
Schematic Diagram, Circuit Board Details, and Parts List
Motorola No. ***PEPS-18067-E***
9/1/80- UP

RECEIVER INTERCONNECT BOARD

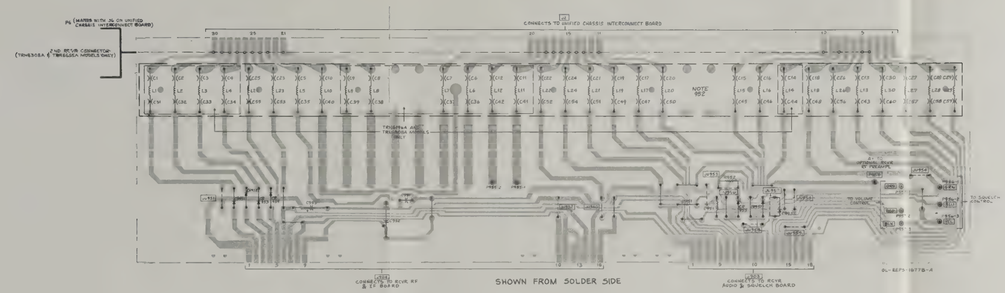
PARTS LIST

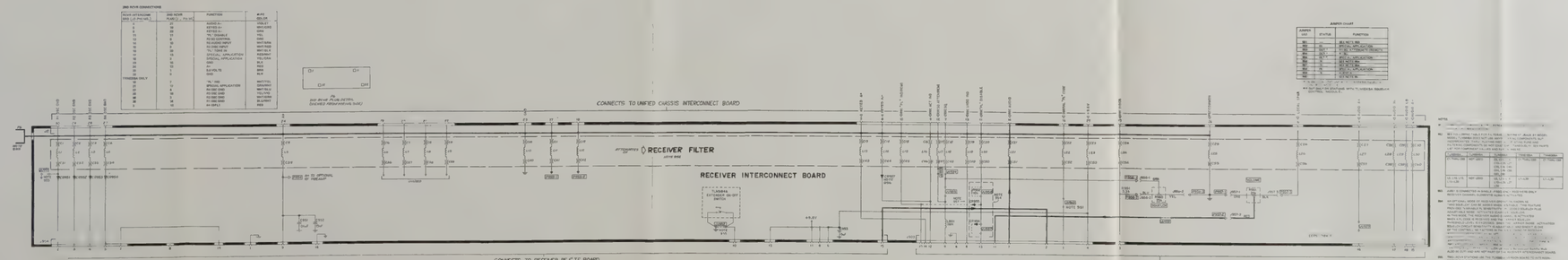
NOTE
This parts list covers five models of the Receiver Interconnect Board. Where differences exist, the model number of the applicable unit is given in the Description column.

TLN5646A/TLN5648A/TLN5655A/TRN6196A/TRN6308A Receiver Interconnect Board — PL-3435-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1 thru 60	21-851219	CAPACITOR, fixed: 1000 pF +100-0%; 500 V (TRN6196A & TRN6308A)
C951	21-82428B59	.01 uF +80-20%; 200 V
C952, 953	23-84762H09	15 uF ±20%; 20 V
CR951 thru 954, 957	23-84762H09	DIODE: (SEE NOTE) silicon
L1 thru 4, 6 thru 9, 11, 12, 14, 15 thru 21, 24, 25, 26	24-83961B01	COIL, rf: 3 turns; coded brown
L5, 10, 13, 22, 23, 27 thru 30, 801	24-83977B01	1-1/2 turns
	24-82549D03	1000 uH
P951	--	CONNECTOR, plug: (TLN5655A) includes:
	14-84556B01	HOUSING, connector
	9-84151B03	CONTACT, receptacle: 14 req'd.
P951	--	(TRN6308A) includes:
	14-84556B01	HOUSING, connector
	9-84151B03	CONTACT, receptacle: 20 req'd.
R951	6-124C61	RESISTOR, fixed: 3.3k ±10%; 1/4 W
	NON-REFERENCED ITEMS	
	7-82626K01	BRACKET, filter
	14-82621B01	INSULATOR (TLN5648A & TLN5655)
	1-80775B75	COVER ASSEMBLY, filter (TLN5646A, TLN5655A, TRN6196A & TRN6308A) includes:
	15-82173K01	COVER, filter
	3-138162	SCREW, tapping: 4-40 x 3/8"; 5 used (TLN5646A, TRN6196A & TRN6308A)
	3-139495	SCREW, tapping: 6-20 x 5/16" 6 used (TLN5646A, TLN5648A, TRN6196A & TRN6308A)
	42-84284B01	RETAINER, screw: 5 used (TLN5646A, TRN6196A & TRN6308A)
	3-139495	SCREW, tapping: 6-20 x 5/16" 7 used (TLN5655A)
	42-82143C02	CLAMP, cable: 1/4" ID; 2 used (TLN5655A)
	42-82143C02	CLAMP, cable: 1/4" ID (TRN6308A)
	42-82143C03	CLAMP, cable: 1/8" ID (TLN5655A & TRN6308A)
	14-82613M02	INSULATOR

NOTE:
For optimum performance, replacement diodes must be ordered by Motorola part number.





FUNCTION

Interconnects various receiver circuit boards to the unified chassis interconnect board. Model differences are primarily rf filtering.

Receiver Interconnect Board
Schematic Diagram, Circuit Board Details, and Parts List
Motorola No. PEPS-18067-E
9/1/80-UP

TONE "PRIVATE-LINE" DECODER

MODEL TRN8834A

NDER" RESONANT

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. At all other freque
d no energy is couple

RCUIT

per PL tone is applied
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soidal wave is ampli
k through C810 r
m. The amplified signa
h converts the signal
with its collector volt
plied. With tone appli
e sinusoidal wave is
t. The positive swing
conduction of Q805 a
ear zero volts. C813
od and discharges thr
filtered dc potential
h Q806. With Q806
the output which u
itch Q807 is also a
oss the noise gate a

ER

L tone from the VO
gh an audio filter
02 and L803. The filt
decoder but physical
This filter is high-pa
and passes the aud

FUNCTION

Unsquelches receiver upon receipt of proper "Private-Line" tone.

MEASURED UNDER FOL-
DITIONS:

L SENSITIVITY SHOWN UNDER
AVEFORM.
NTAL DEFLECTION = 5 msec/DIV.
CEIVER OPERATING PROPERLY:

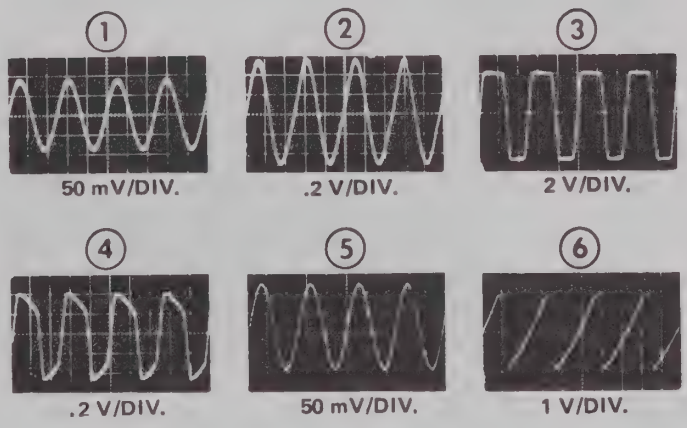
CT 1000 uV RF CARRIER AT
ENNA CONNECTOR.
ULATE CARRIER WITH
" TONE. ADJUST MODULA-
N FOR WAVEFORM ① ;
60 mV rms (170 mV P-P) AT
-2.

ER NOT USED:

ECT "PL" TONE AT J201-2.
JUST TONE LEVEL FOR
VEFORM ① .

OSCOPE VERTICAL INPUT -- AC.
OSCOPE SYNC -- INTERNAL.
REMENTS MADE WITH RESPECT
SSIS GROUND.

"PL" DECODER WAVEFORMS



EPS-6182-B

TECHNICAL CHARACTERISTICS

Frequency Determining Device	"Vibrasponder" resonant reed
PL Tone Frequency	Selected from 67-210 Hz range
Tone Accuracy	±0.15%
Tone Bandwidth	Approximately 1 Hz
Tone Sensitivity	0.25 volt ac rms reed drive
Output	9.5 volts dc switched
Power Requirement	9.6 volts dc @15 milliamperes

1. DESCRIPTION

This decoder provides a dc output voltage to unsquelch the receiver's audio section only when the proper PL tone is received. The decoder will respond only to a specific, continuous low-frequency tone from a transmitter in the same "Private-Line" network.

2. FUNCTIONAL OPERATION

2.1 GENERAL

2.1.1 PL Tone Present

2.1.1.1 The PL filter passes low frequency PL tones and attenuates signals above 300 Hz. The noise switch shorts out high frequency noise signals. The tone from the PL filter is limited to a fixed level by the amplifier/clipper and then applied to the "Vibrasponder" resonant reed which vibrates when the tone is the same frequency as the reed's resonant frequency. When the reed is vibrating, the tone is applied to a detector which develops a dc output which activates the output switch. When the output switch is activated, 9.5 volts is present at its output to enable the audio circuits. The output also activates the noise switch.

2.1.1.2 A separate high pass audio filter is located on the PL decoder board which allows voice signals above 300 Hz to pass but blocks PL tones. This filter is connected in series with the audio signal path to prevent the PL tone from being heard in the speaker.

2.1.2 PL Tone Absent

When no PL tone is present, the output switch is off. The output voltage is 0 volts at this time which inhibits the squelch circuit to prevent an audio output to the speaker. The noise switch is off at this time which allows high frequency noise to bypass the PL filter. The presence of high frequency noise desensitizes the amplifiers and acts as an "anti-falsing" feature to prevent a random low-frequency noise signal from activating the resonant reed.

2.2 DECODER INPUT CIRCUITS

2.2.1 The receiver discriminator output signal consists of noise only when no carrier signal is being received. With a carrier signal input to the receiver, the noise is reduced and voice audio or voice audio and PL tone added.

2.2.2 These input signals are routed through the low pass filter and noise gate circuit. A receiver input signal that is modulated ± 0.05 kHz with PL tone produces a nominal 60 millivolts rms signal at the input to the decoder. The low pass filter consisting of L801, C802, C803 and C805 attenuates sharply all signals above 300 Hz. Thus, voice and noise signals above 300 Hz are blocked but PL tones are passed. High pass filter C801, R803, and C807 presents a parallel path for high frequency noise whenever the decoder is not activated. This condition is desirable so that low frequency noise (only) will not falsely activate the decoder. When the proper tone has been received and the decoder is activated, noise switch Q807 acts as a short and grounds all high frequency signals before they reach amplifier Q801.

2.3 INPUT AMPLIFIER CIRCUITS

Amplifier Q801 amplifies noise and PL tone signals which are coupled to amplifier/clipper Q802. Diode CR801 and the base emitter junction of Q802 limit both the positive and negative swing of the signal to a maximum amplitude. The amplitude output of Q802 provides a constant amount of drive even though the amount of PL tone deviation from various transmitters is not constant. It also limits the noise signals to prevent oversensitivity to noise signals which could falsely operate the "Vibrasponder" resonant reed. "Vibrasponder" driver Q803 operates as an emitter follower to provide current drive to the low impedance "Vibrasponder" resonant reed.

2.4 "VIBRASPONDER" RESONANT REED

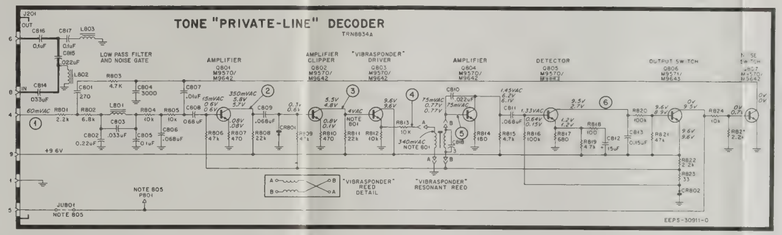
At resonance, the reed acts as a high Q transformer coupling energy from the primary to the secondary winding. At all other frequencies, the reed will not vibrate and no energy is coupled to the secondary winding.

2.5 OUTPUT CIRCUIT

When the proper PL tone is applied to the reed, it develops a sinusoidal wave output at its resonant frequency. This sinusoidal wave is amplified by Q804. Negative feedback through C810 maintains the sinusoidal waveform. The amplified signal is coupled to detector Q805 which converts the signal to a dc potential. Q805 is cut off with its collector voltage of 9.6 volts until the tone is applied. With tone applied, the positive most portion of the sinusoidal wave is clamped at approximately .6 volt. The positive swing of each cycle causes momentary conduction of Q805 and the collector voltage drops to near zero volts. C813 charges during the conduction period and discharges through R820 and R821 to develop a filtered dc potential which forward biases output switch Q806. With Q806 activated, 9.6 volts is gated to the output which unsquelches the receiver. Noise switch Q807 is also activated which places a short across the noise gate as explained in paragraph (b).

2.6 AUDIO FILTER

Audio and PL tone from the VOLUME control are routed through an audio filter consisting of C814-C817 and L802 and L803. The filter is electrically separate from the decoder but physically mounted on the same board. This filter is high-pass type which blocks the PL tone and passes the audio to the audio and squelch board.



NOTES:

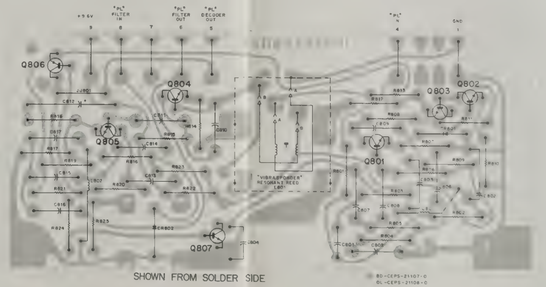
B01 DUE TO SQUARE WAVE CHARACTERISTIC SOME METERS RESPOND DIFFERENTLY. VOLTAGE SHOULD BE MEASURED WITH AN OSCILLOSCOPE.

B02 AC VOLTAGE READINGS ARE RMS VALUES WITH MEASURED WITH 60 MILLIVOLTS "PL" TONE INPUT. USE HIGH IMPEDANCE (1 MEGOHM) AC VOLTMETER. MEASUREMENT MADE WITH RESPECT TO CHASSIS GROUND.

B03. DC VOLTAGE READINGS TAKEN WITH HIGH IMPEDANCE (1 MEGOHM) DC VOLTMETER. TOP VALUE IS MEASURED WITHOUT "PL" TONE. BOTTOM VALUE IS MEASURED WITH 60 MILLIVOLTS "PL" TONE INPUT. MEASUREMENT MADE WITH RESPECT TO CHASSIS GROUND.

B04 UNLESS OTHERWISE STATED RESISTOR VALUES ARE IN OHMS. CAPACITOR VALUES ARE IN MICROFARADS

B05 JUMPER J2001 AND P801 ARE INCORPORATED IN MODEL TRN8834A ONLY. J2001 IS REMOVED AND P801 IS USED ONLY FOR CERTAIN OPTIONAL EQUIPMENT.



SHOWN FROM SOLDER SIDE

B0-CEPS-21107-O
B1-CEPS-21108-O

TONE "PRIVATE-LINE" DECODER

MODEL TRN8834A

[redacted]

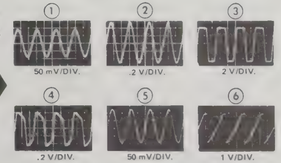
FUNCTION

Unsquelches receiver upon receipt of proper "Private-Line" tone.

WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM
2. HORIZONTAL DEFLECTION = 5 msec/DIV.
3. WITH RECEIVER OPERATING PROPERLY
   - A. INJECT 1000 uV RF CARRIER AT ANTENNA CONNECTOR
   - B. MODULATE CARRIER WITH "PL" TONE. ADJUST MODULATION FOR WAVEFORM ①. I.E. 60 mV rms (170 mV P-P) AT J2001
4. RECEIVER NOT USED
   - A. INJECT "PL" TONE AT J201-2
   - B. ADJUST TONE LEVEL FOR WAVEFORM ①
5. OSCILLOSCOPE VERTICAL INPUT - AC
6. OSCILLOSCOPE SYNC - INTERNAL
7. MEASUREMENTS MADE WITH RESPECT TO CHASSIS GROUND

"PL" DECODER WAVEFORMS



EPS 6182-B

68P81050E66-O
9/1/80 LD

Troubleshooting

If the PL decoder does not operate, or operates ıproperly, the following hints may be helpful in cating the malfunction.

(1) Testing the "Vibrasponder" Resonant Reed

One of the first tests should be a check of e "Vibrasponder" resonant reed. Inject a 340 illivolt rms PL tone of the proper frequency directly to e primary of the reed. Use an oscilloscope or ac ɔltmeter to check the output across the secondary of e reed. Approximately 75 millivolts rms should be easured. If the reed is good, continue with other :coder tests.

(2) Decoder Testing

To test the decoder, inject a 1000 microvolt ırrier signal into the receiver. Adjust PL modualtion ır 60 millivolts rms tone signal at the input to the :coder (test point 1 on the schematic diagram and rcuit board detail). If the PL tone is injected directly to the decoder for testing, an rf carrier signal should : injected into the receiver to quiet the receiver noise. therwise, noise and PL tone will both be present and ill produce erroneous readings.

With 60 millivolts PL tone input, measure gnal and dc voltages at various points in the decoder to olate the trouble. Typical values for a normally ɔerating decoder are given on the schematic diagram. ɔme waveforms are not sinusoidal and should be easured with an oscilloscope. Most ac voltmeters are ılibrated to read accurately only for sinusoidal signals.

If under normal operating conditions, the L tones are heard with the speaker audio, the high pass lter on the decoder board should be checked.

NOTE

The PL decoder can be removed from its normal position in the receiver chassis and plugged on the front or circuitry side of the audio board. Parallel-connected pins have been provided for ease of servicing. Remove the audio board shield for access to these pins.

"DIGITAL PRIVATE-LINE" DECODER

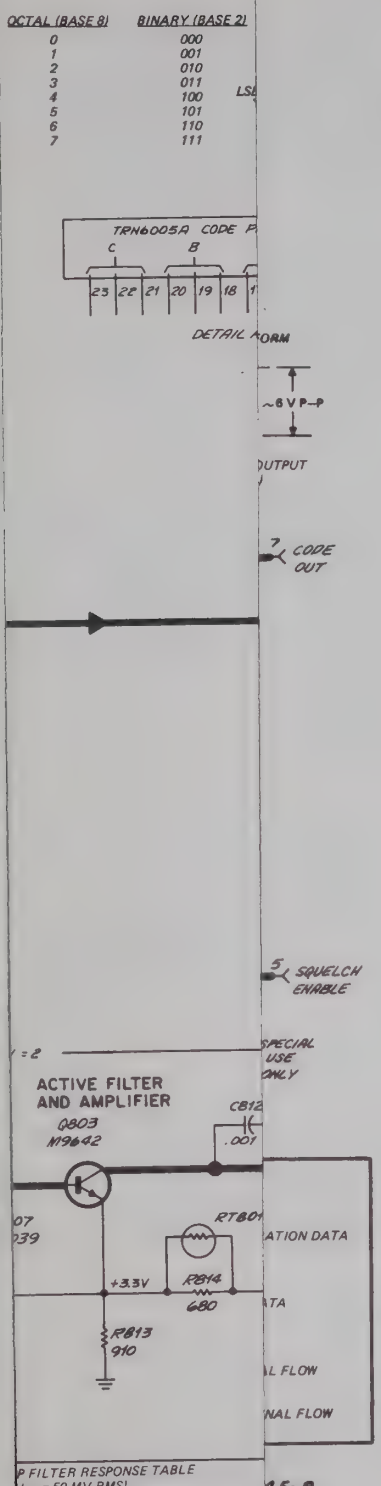
MODEL TLN5729A

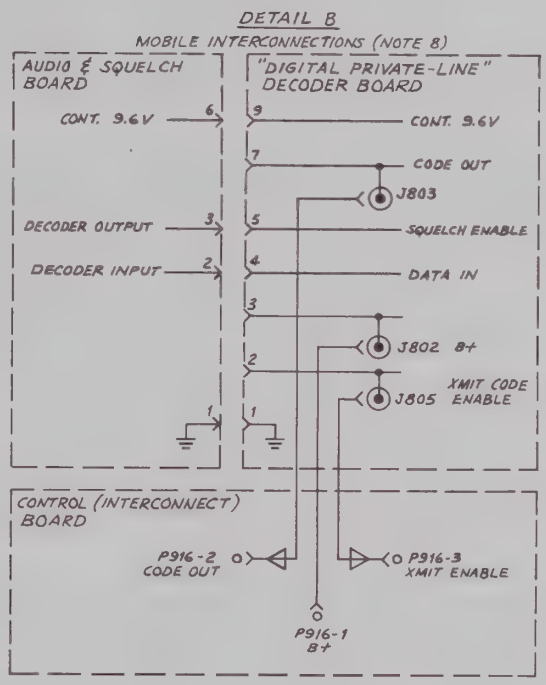
FUNCTION

1. Decodes A 23-bit binary code word to unsquelch the receiver.
2. In radios with simplex "Digital Private-Line" operation, generates a 23-bit binary code word when the transmitter is keyed.

TECHNICAL CHARACTERISTICS

CODE DETERMINING DEVICE	TRN6005A CODE PLUG
CODE FORMAT	23-BIT WORD
CODE FREQUENCY SPECTRUM	11-67 Hz
OUTPUT	SWITCHED 5.3 V DC





electrical parts list

IMPORTANT
Use **ONLY** the following Motorola part numbers when ordering replacement parts.

TRN8834A Tone "Private-Line" Decoder — PL-7066-O

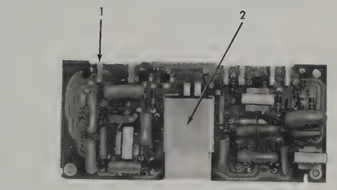
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%, 50 V: unless otherwise stated
C801	21-82187B38	270 pF
C802	8-82905G32	0.22
C803	8-82905G08	.033; 100 V
C804	21-82187B26	0.003; 100 V
C805	8-83813H08	0.1; 100 V
C806	8-82905G04	.068; 100 V
C807	8-82905G01	.01
C808, 809	8-82905G04	.068; 100 V
C810	8-82905G02	.022
C811	8-82905G04	.068; 100 V
C812	23-83214C02	15 ± 20%; 25 V
C813	8-82905G31	0.15
C814	8-83293B10	.033 ± 5%
C815	8-83813H15	.022 ± 5%
C816	8-82905G30	0.1
C817	8-82096G14	0.1 ± 5%; 200 V
C818	21-83406D51	3 pF ± 0.25 pF; 500 V
		diode: (see note I) silicon
CR801, 802	48-83654H01	
		"Vibrasponder" resonant reed: (see note II)
E801	TLN8381A	plug-in unit
		coil, rf; choke:
L801, 802, 803	24-84003A01	6 H
		transistor: (see note I)
Q801 thru 805	48-869642 or	NPN, type M9642
	48-869570	NPN, type M9570
Q806	48-869643 or	PNP, type M9643
	48-869571	PNP, type M9571
Q807	48-869642 or	NPN, type M9642
	48-869570	NPN, type M9570
		resistor, fixed: ± 5%; 1/4 W unless otherwise stated
R801	6-124C57	2.2k ± 10%
R802	6-124C69	6.8k ± 10%
R803	6-124A85	4.7k
R804, 805	6-124C73	10k ± 10%
R806	6-124A89	47k
R807	6-124A41	470
R808	6-124A81	22k
R809	6-124A89	47k
R810	6-124A41	470
R811	6-124A81	22k
R812	6-124C73	10k ± 10%
R813	6-124C73	10k ± 10%
R814	6-124A31	180
R815	6-124A85	4.7k
R816	6-124A97	100k
R817	6-124A45	680
R818	6-124C25	100 ± 10%
R819	6-124A85	4.7k
R820	6-124A97	100k
R821	6-124A89	47k
R822	6-124A57	2.2k
R823	6-124A13	33
R824	6-124C73	10k ± 10%
R825	6-124C57	2.2k ± 10%

notes:
I For optimum performance, replacement diodes and transistors must be ordered by Motorola part numbers
II The "Vibrasponder" Resonant Reed (Model TLN8381A) is not part of the decoder board. When ordering the complete board, the reed must be ordered separately

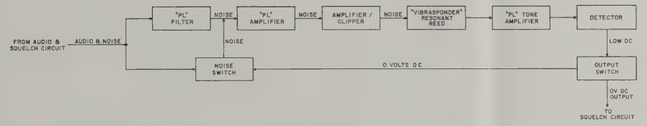
mechanical parts list

TRN8834A Tone "Private-Line" Decoder — PL-7067-O

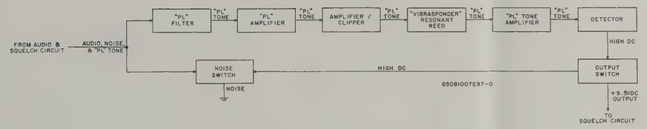
ITEM	MOTOROLA PART NO.	DESCRIPTION
1	9-830111H01	TERMINAL, pin; female: 6 req'd
2	42-84116B01	SOCKET & CLAMP ASSY
3	3-138905	SCREW, lock; No. 4 x 5_{32}"; 2 req'd.
4	42-82484B01	RETAINER, nylon; 2 req'd.
5	7-84222B01	BRACKET, retainer



"PL" TONE ABSENT



"PL" TONE PRESENT



MAINTENANCE

a. Recommended Test Equipment

(1) Motorola R1010 Series RF Signal Generator. This solid-state unit provides receiver rf carrier signals.

(2) Motorola SLN6221A PL Tone Generator and "Vibrasender" resonant reed on the same frequency as the "Vibrasponder" resonant reed of the decoder. An audio signal generator may be used if it is accurately set to the decoder frequency. However, to obtain the accuracy necessary, the frequency should be adjusted while the signal is measured on a frequency counter.

(3) Motorola Solid-State Oscilloscope for tone signal measurement. Some measurements may be taken with a high impedance ac voltmeter.

(4) Motorola Solid-State DC Multimeter for dc voltage measurements.

b. Performance Tests

A 0.25 microvolt rf carrier signal modulated ± 0.5 kHz with PL tone should unsquelch the receiver. This can be checked as follows:

(1) Connect the rf signal generator to the receiver rf input receptacle. Set the signal generator to the receiver carrier frequency, then set the output to minimum.

(2) Modulate the signal generator output ± 0.5 kHz with a PL tone of the frequency stamped on the "Vibrasponder" resonant reed. The tone can be generated with a Motorola SLN6221A PL Tone Generator and a "Vibrasponder" resonant reed. The "Vibrasender" reed from the PL encoder may be used if it is the proper frequency.

(3) Also modulate the signal generator with an audio tone in the 300 to 3000 Hz range at ± 3.3 kHz.

(4) Increase the output of the signal generator until the receiver unsquelches and the audio tone is heard on the speaker. No more than 0.25 microvolt should be required to unsquelch the receiver.

c. Troubleshooting

If the PL decoder does not operate, or operates improperly, the following hints may be helpful in locating the malfunction.

(1) Testing the "Vibrasponder" Resonant Reed

One of the first tests should be a check of the "Vibrasponder" resonant reed. Inject a 340 millivolt rms PL tone of the proper frequency directly to the primary of the reed. Use an oscilloscope or ac voltmeter to check the output across the secondary of the reed. Approximately 75 millivolts rms should be measured. If the reed is good, continue with other decoder tests.

(2) Decoder Testing

To test the decoder, inject a 1000 microvolt carrier signal into the receiver. Adjust PL modualtion for 60 millivolts rms tone signal at the input to the decoder (test point 1 on the schematic diagram and circuit board detail). If the PL tone is injected directly into the decoder for testing, an rf carrier signal should be injected into the receiver to quiet the receiver noise. Otherwise, noise and PL tone will both be present and will produce erroneous readings.

With 60 millivolts PL tone input, measure signal and dc voltages at various points in the decoder to isolate the trouble. Typical values for a normally operating decoder are given on the schematic diagram. Some waveforms are not sinusoidal and should be measured with an oscilloscope. Most ac voltmeters are calibrated to read accurately only for sinusoidal signals.

If under normal operating conditions, the PL tones are heard with the speaker audio, the high pass filter on the decoder board should be checked.

NOTE

The PL decoder can be removed from its normal position in the receiver chassis and plugged on the front or circuitry side of the audio board. Parallel-connected pins have been provided for ease of servicing. Remove the audio board shield for access to these pins.

"DIGITAL PRIVATE-LINE" DECODER

MODEL TLN5729A

FUNCTION

1. Decodes A 23-bit binary code word to unsquelch the receiver.
2. In radios with simplex "Digital Private-Line" operation, generates a 23-bit binary code word when the transmitter is keyed.

TECHNICAL CHARACTERISTICS

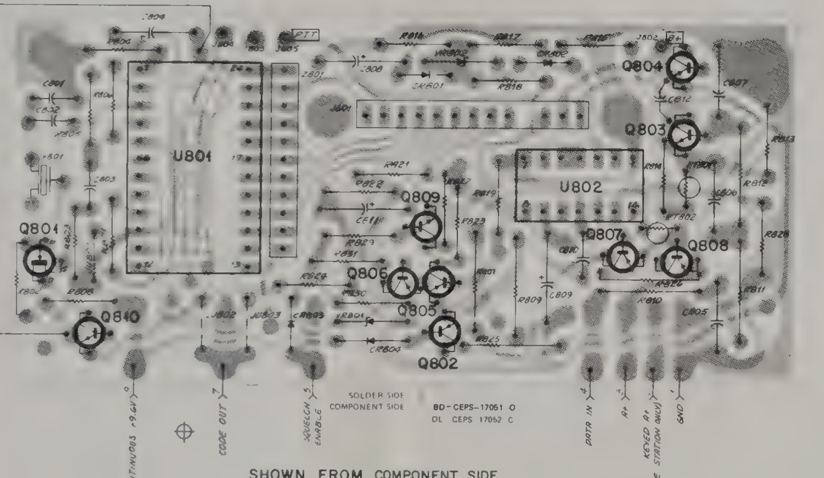
CODE DETERMINING DEVICE	TRN6005A CODE PLUG
CODE FORMAT	23-BIT WORD
CODE FREQUENCY SPECTRUM	[illegible]
OUTPUT	SWITCHED 5.3 V DC

PARTS LIST

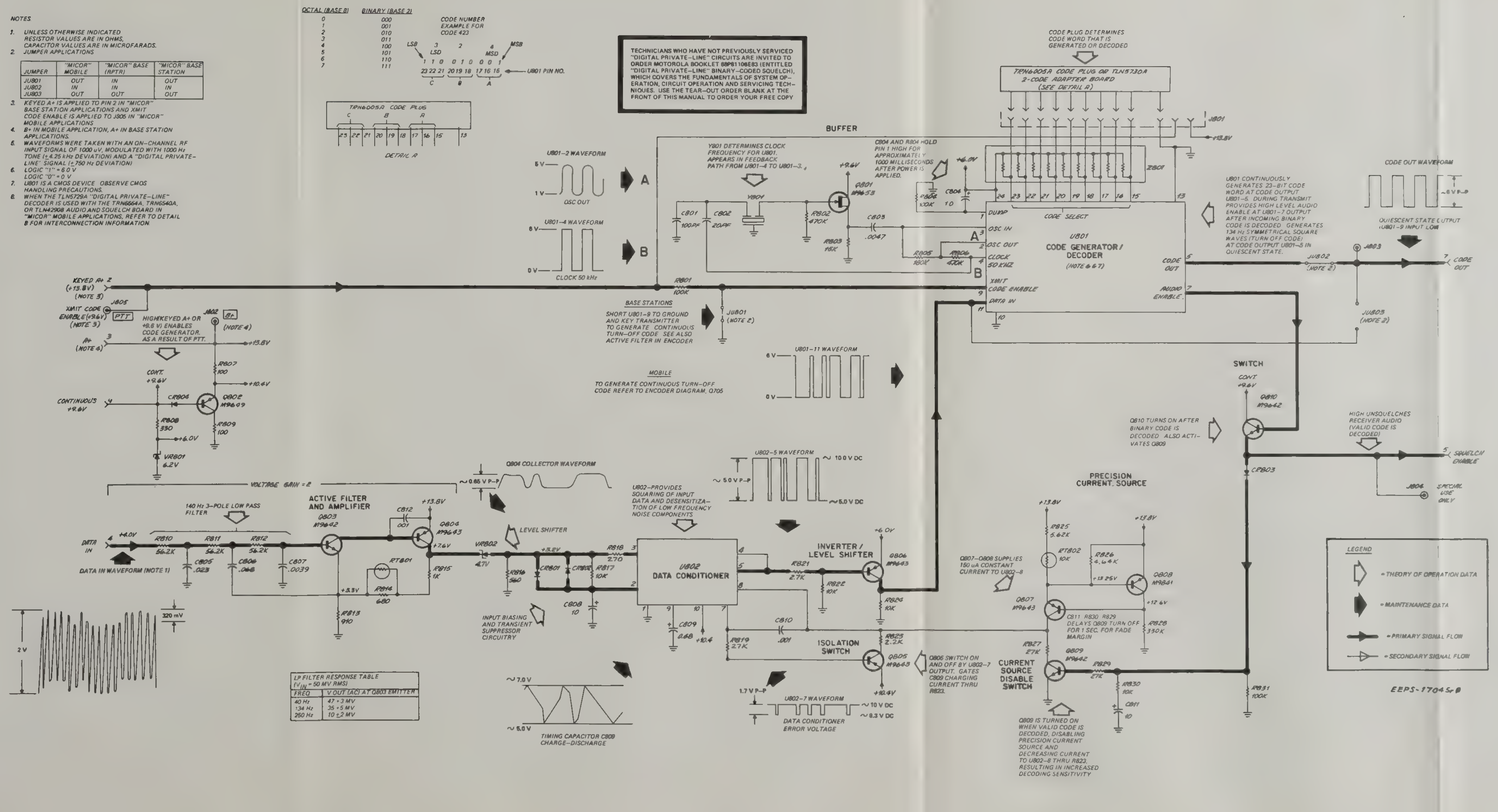
TLN5729A Decoder Circuit Board PL-3299-A

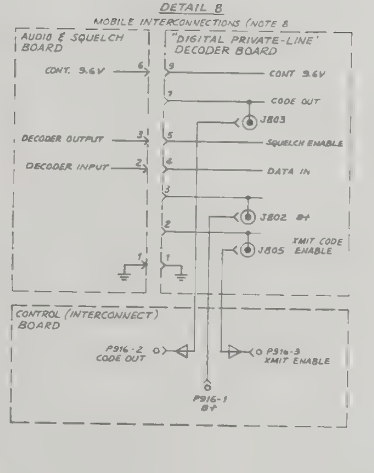
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF:
C801	21-83798B01	100 pF ±5%; 200 V
C802	21-82610C22	20 pF ±5%; 200 V
C803	21-82428B56	.0047 ±10%; 100 V
C804	23-82783B08	1.0 ±20%; 35 V
C805	8-82905G39	.023 ±5%; 50 V
C806	8-83813H23	.068 ±5%; 50 V
C807	8-83813H19	.0039 ±5%; 50 V
C808, 811	23-84762H03	10 ±10%; 20 V
C809	23-82783B48	0.68 ±5%; 35 V
C810	21-82187B20	1000 pF ±10%; 100 V
		DIODE: (SEE NOTE)
CR801, 802	48-84616A01	hot carrier
CR803	48-83654H01	silicon
CR804	48-82139G01	germanium
		TRANSISTOR: (SEE NOTE)
Q801	48-869653	field-effect; type M9653
Q802	48-869649	PNP; type M9649
Q803, 809, 810	48-869642	NPN; type M9642
Q804, 805, 806, 807	48-869643	PNP; type M9643
Q808	48-869841	PNP; type M9841
		RESISTOR, fixed: ±10%: 1/4 W; unless otherwise stated
R801, 804, 831	6-124C97	100k
R802, 806	6-124D14	470k
R803	6-124C77	15k
R805	6-124D04	180k
R807, 809	6-125C25	100 :1/2 W
R808	6-124C37	330
R810, 811, 812	6-13755C64	56.2k ±1%
R813	6-124A48	910 ±5%
R814	6-124A45	680 ±5%
R815	6-124A49	1k ±5%
R816	6-124C43	560
R817, 822, 824, 830	6-124C73	10k
R818	6-124C35	270
R819	6-124C83	27k
R821	6-124A59	2.7k
R823	6-124A57	2.2k ±5%
R825	6-13755C67	5620 ±1%
R826	6-10621C59	4640 ±1%
R827, 829	6-124C83	27k
R828	6-124B10	330k ±5%
		THERMISTOR:
RT801	6-865641	300 ohm @ 25°C
RT802	6-82696B01	10k ohms @ 25°C
		INTEGRATED CIRCUIT: (SEE NOTE)
U801	51-84267A82	M6782
U802	51-84320A55	M2055
		VOLTAGE REGULATOR:
VR801	48-83696E07	Zener type; 6.2 V
VR802	48-82256C03	Zener type; 4.70 V
		CRYSTAL:
Y801	48-82003K01	resonator; 50.00000 KC
		RESISTOR NETWORK:
Z801	1-80772B36 or 51-82142K02	pull-up, 10-pin

NOTE: For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.



SHOWN FROM COMPONENT SIDE



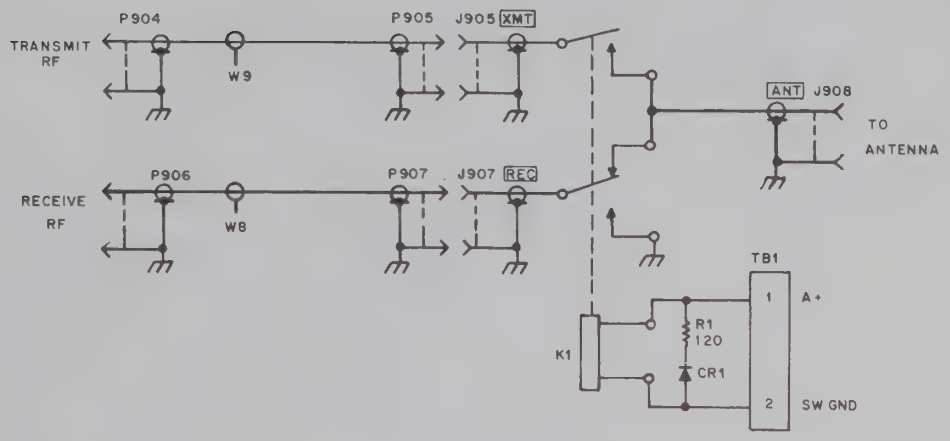


ANTENNA CHANGEOVER RELAY

MODEL TRN5040A, WITH BRACKET
MODEL TRN6572A, WITHOUT BRACKET

FUNCTION

The antenna changeover relay is used in base stations only. It provides switching of the antenna between the station's transmitter output and receiver input.



BEPS-33515-O

parts list

TRN5040A Antenna Changeover Relay with Bracket
TRN6572A Antenna Changeover Relay without Bracket — PL-7750-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode: (see note)
CR1	48-82466H13	silicon
		relay, coaxial antenna:
K1	80-84654C03	13.6 V
		connector, plug:
P904, 905	28-852527	male; type "M"
P906	28-84967D01	male; type "BNC"
P907	28-852527	male; type "N"
		resistor, fixed:
R1	6-125C27	120 ± 10%; 1/2 W
		terminal board:
TB1	31-131745	strip, terminal
		wire assembly:
W8	1-80788B54	includes: ref. items P906 and P907 30-84173E01 CABLE, coaxial: 37" used (RCVR input)
W9	1-80788B55	includes: ref. items P904 and P905 30-84173E01 CABLE, coaxial: 7" used (XMTR output)
		mechanical parts
	3-7196	SCREW, machine; 4-40 x 1/8"
	3-136212	SCREW, machine; 1/4-20 x 7/8"; 4 used
	4-7667	LOCKWASHER; #4 external
	7-82792N01	BRACKET, antenna relay (TRN5040A only)
	37-82603D60	SLEEVING, black; 2 used
	39-10184A24	CONTACT, receptacle; 2 used
	42-10217A02	STRAP, tie; .091 x 3.62"; 8 used
	42-10217A10	STRAP, tie; 0.184 x 7.78"

note: For optimum performance diodes must be ordered by Motorola part numbers.

HANDLING PRECAUTIONS FOR CMOS INTEGRATED CIRCUITS

Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. However, CMOS circuits can be damaged by improper handling of the modules even in a system.

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions:

(1) Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch both hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

(2) Whenever possible avoid touching any electrically conductive parts of the circuit module with your hands.

(3) Normally, circuit modules can be inserted or removed with power applied to the unit. However, check the INSTALLATION and MAINTENANCE sections of the manual as well as the module schematic diagram to insure there are no objections to this practice.

(4) When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

5) All electrically powered test equipment should be grounded. Apply the ground lead from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.

(6) If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through a resistance of approximately 100k.

WARNING

If the aluminum foil is connected directly to ground, be cautious or possible electrical shock from contacting the foil at the same time as other electrical circuits.

(7) When soldering, be sure the soldering iron is grounded.

(8) Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

(9) When replacing a CMOS integrated circuit device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.

(10) All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

11) Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a similar material (aluminum foil may be used). NEVER USE NONCONDUCTIVE MATERIAL for packaging these modules.

EPS-18293-O

"DIGITAL PRIVATE-LINE" DECODER BOARD TROUBLESHOOTING CHART

NOTES:

1. To obtain a test code for the following procedure apply a carrier frequency signal to the receiver rf input from an rf signal generator modulated by the code output of a Motorola SLN6413A "Digital Private-Line" Test Set. Be sure the signal generator is able to accept very low frequency modulation (less than ±5 Hz).
2. Before you replace U801, use the following procedure to verify that U801 is malfunctioning:
   a. Connect U801-11 to the code input of a Motorola SLN6413A "Digital Private-Line" Test Set.
   b. Apply a carrier-frequency signal to the receiver rf input from a signal generator that is modulated by the code output of the test set.

   If proper decode is indicated, U801 must be replaced. If U801 must be replaced, refer to the CMOS handling precautions.

SYMPTOM	PROBABLE CAUSE	ACTION
No decode, but received audio is good when PL is disabled.	1. Audio squelch is malfunctioning.	Remove the decoder board. Apply +9.6 V at P201-3 on audio & squelch board. If audio is not enabled, troubleshoot audio & squelch circuits.
	2. No 50 kHz clock	Check U801-4 for 50 kHz clock pulses. Rise time must be ≤750 n sec.
	3. Audio enable switch is malfunctioning.	If U801-7 is high, but circuit board pin 5 is low when receiving code, replace Q810.
	4. Dump pin U801-1 is always high.	Check U801-1 should always be 0 V.
	5. Wrong or bad code plug.	Replace with a known good code plug. Check U801-15 through U801-23 for proper octal code.
	6. No data into U801.	Check U801-11 for 0 - 6 V pulses. If pulses are not present, check Q806 and U802 operation.
	7. Transmit code enable input is high.	Ground U801-9. If a received code is properly decoded, check for a malfunction in the delayed transmit enable circuit on the encoder board.
	8. U801 has an internal malfunction.	If, after checking causes 1 through 7, the cause of the problem has not been isolated, replace U801. CAUTION U801 is a CMOS device and may be damaged by improper handling. Refer to the CMOS handling precautions in this instruction section.
Excessive decoder falsing when monitoring an inactive channel (noise falsing).	1. Precision current source is low or inoperative.	Measure the dc voltages in the precision current source circuits. Current to U801-8 = (V_{BE} of Q808) (R825 + R826 +RT802)/ R826 (R825 + RT802)
	2. Current source disable switch is always on.	Check for 8 - 10 V at Q809 collector. If Q809 collector is 0 V, replace Q809.
	3. Improper 140 Hz low pass filter response.	Check dc voltages in filter circuit. Check the filter frequency response. Measured at Q803 emitter, the filter response should be -1.0 to -4.0 dB at 134 Hz and -12 to -15 dB at 250 Hz with 50 mV rms signal at decoder input.
	4. U802 supply voltage is too high.	Check U802-10 for +10.4 V ±0.2 V dc. If voltage is high, troubleshoot the +10.4 V regulator on the decoder board.
Excessive squelch tails (approx. 500 msec noise burst) at ends of received transmissions	1. Turn-off code not being transmitted by other radio unit.	Monitor circuit board pin 4 (DATA IN) for presence of turn-off code at ends of transmissions.
	2. U802 lock-in malfunction	Ground Q809 collector. With a 300 mV p-p signal at circuit board pin 4 (DATA IN), the waveform at U802-4 should be locked in to the input signal up to at least 175 Hz. If proper lock-in does not occur, replace C809, then check lock-in again. If lock-in is still bad, replace U802.
	3. U801 turn-off code detector is malfunctioning.	Check U801 (Note 2).
Poor detector sensitivity in poor quieting conditions	1. Improper 140 Hz low pass filter response response.	Check dc voltages in filter circuit. Check the filter frequency response; measured at Q803 emitter, the filter response should be -1.0 to -4.0 dB at 134 Hz and -12 to -15 dB at 250 Hz with 50 mV rms signal at decoder input.
	2. Precision current source supplying too much current to U802-8.	Measure the dc voltages in the current source circuits. Current to U802-8 = (V_{BE} of Q808) (R825 + R826 + RT802) R826 (R825 + RT802)
	3. Current source disable switch inoperative.	While detecting a valid code, check Q809 collector for 0 V dc. If 8-10 V is present, replace Q809.
Occassional squelch tail about 1 second after the end of a transmission from another radio	Current source disable switch is staying on too long.	Check Q809 collector. Q809 collector should go from 0 V dc to 8-10 V within 1.5 seconds after loss of audio squelch disable.

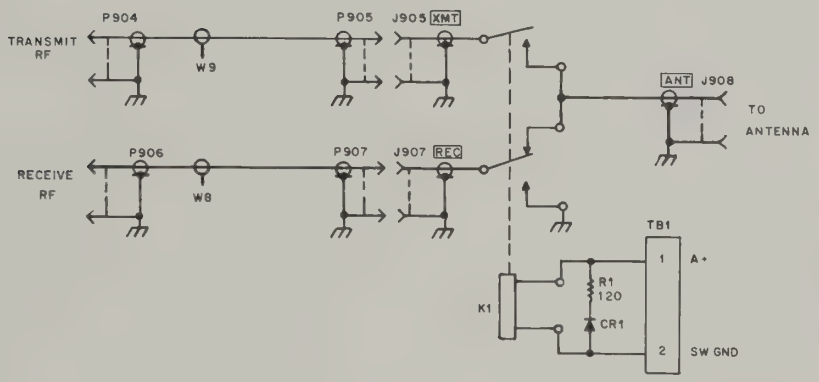
EPS-17705-C

ANTENNA CHANGEOVER RELAY

MODEL TRN5040A, WITH BRACKET
MODEL TRN6572A, WITHOUT BRACKET

FUNCTION

The antenna changeover relay is used in base stations only. It provides switching of the antenna between the station's transmitter output and receiver input.



parts list

BEPS-33515-O

TRN5040A Antenna Changeover Relay with Bracket
TRN6572A Antenna Changeover Relay without Bracket PL-7750-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode: (see note)
CR1	48-82466H13	silicon
		relay, coaxial antenna:
K1	80-84654C03	13.6 V
		connector, plug:
P904, 905	28-852527	male; type "M"
P906	28-84967D01	male; type "BNC"
P907	28-852527	male; type "N"
		resistor, fixed:
R1	6-125C27	120 ± 10%; 1/2 W
		terminal board:
TB1	31-131745	strip, terminal
		wire assembly:
W8	1-80788B54	includes: ref. items P906 and P907 30-84173E01 CABLE, coaxial: 37" used (RCVR input)
W9	1-80788B55	includes: ref. items P904 and P905 30-84173E01 CABLE, coaxial: 7" used (XMTR output)
		mechanical parts
	3-7196	SCREW, machine; 4-40 x 1/8"
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	4-7667	LOCKWASHER; #4 external
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	42-10217A10	STRAP, tie; 0.184 x 7.78"

note: For optimum performance diodes must be ordered by Motorola part numbers.

HIGH VOLTAGE POWER SUPPLY

MODEL TPN1147A

1. DESCRIPTION

This power supply produces various dc voltages which are used to operate a vacuum tube type high power rf amplifier for the transmitter and ac voltages which are used to drive the companion TPN1148A Low Voltage Power Supply. The voltages produced for operation of the power amplifier are:

-- 1500 V dc plate voltage
-- 50 V dc bias voltage

The power supply uses a constant voltage ferroresonant transformer to provide the basic operating voltages to the rectification circuits. This transformer maintains the output voltages within ±3% with a ±20% change in input line voltage.

CAUTION

The input power must maintain an operating frequency to within ±3 Hz in order to keep within the regulation characteristics of the transformer.

The power supply contains an interlock protection circuit which prevents high voltages from being produced unless the station interlocks are enabled (closed).

WARNING - HIGH VOLTAGE

Extreme care must be exercised when servicing this equipment. Do not defeat interlock switches. It is a good practice to assume that HIGH VOLTAGES are present at all times, even after the ac input power is removed from the station.

2. FUNCTIONAL OPERATION

The ac input to the power supply is routed through TB1 and F1 to T1 and T2. Two voltages are produced by half-wave rectification; the +50 V dc PA tube bias and the station safety interlock voltage. The interlock voltage is routed through the interlock switches and back to the power supply to energize K1. AC power is applied through the closed contacts of K1 to T1. The multiple winding secondary of T1 provides voltages to power the full wave rectifier network for the +1500 V dc and the companion low voltage power supply.

The filament control input to the filament regulator board through TB1-4 is enabled as follows. The transmitter turn-on switched A-function (C3) is applied through Q57 to Schmitt trigger Q56 and Q55. The Schmitt Trigger sets bistable multivibrator Q54 and Q53 so that Q53 is cut off and Q54 is turned on. The high at the collector of Q53 causes switch Q52 to turn on and create a current path through TB1-4 to the filament control input (see paragraph 2.3 in section 68P81031E53.

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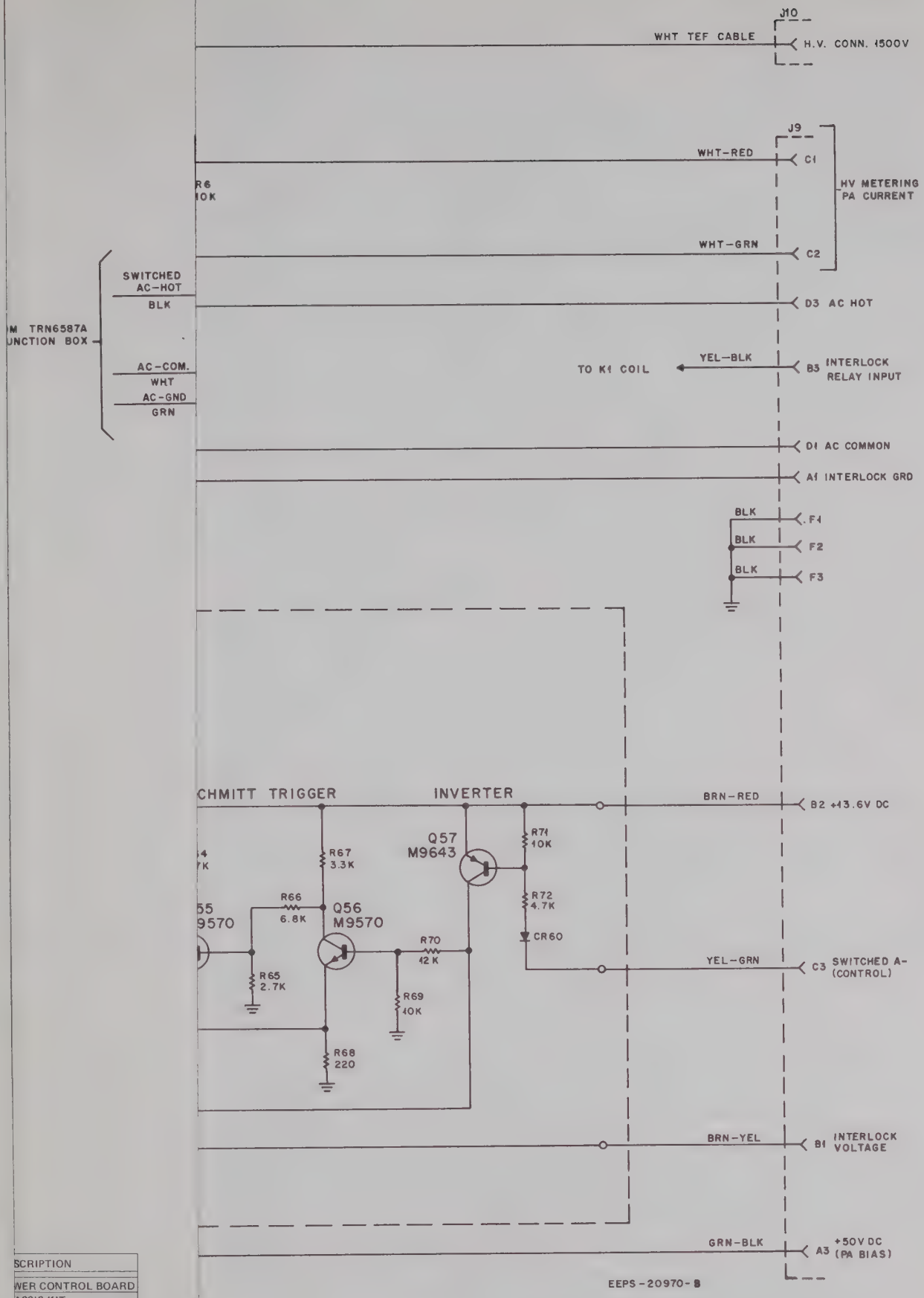
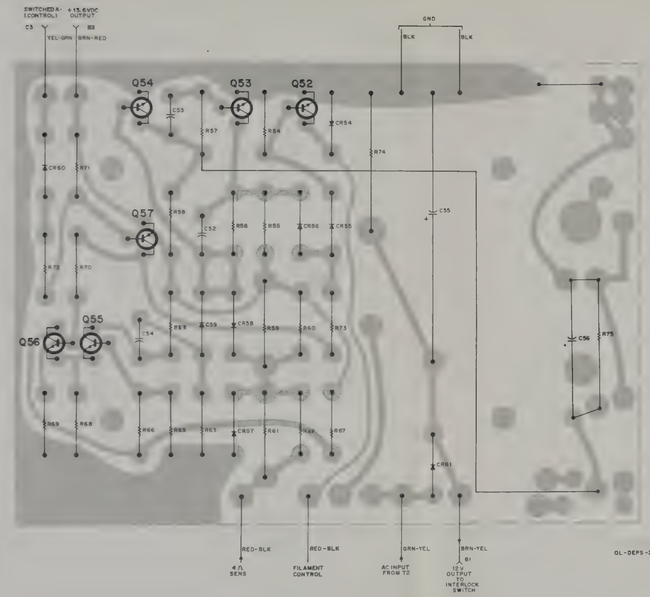


HIGH VOLTAGE POWER SUPPLY

SCRIPTION
WER CONTROL BOARD
ASSIS KIT
BLE KIT

EPS-22427-O

TPN1147A High Voltage Power Supply
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-20971-C
9/1/80-UP



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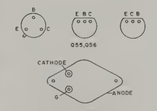
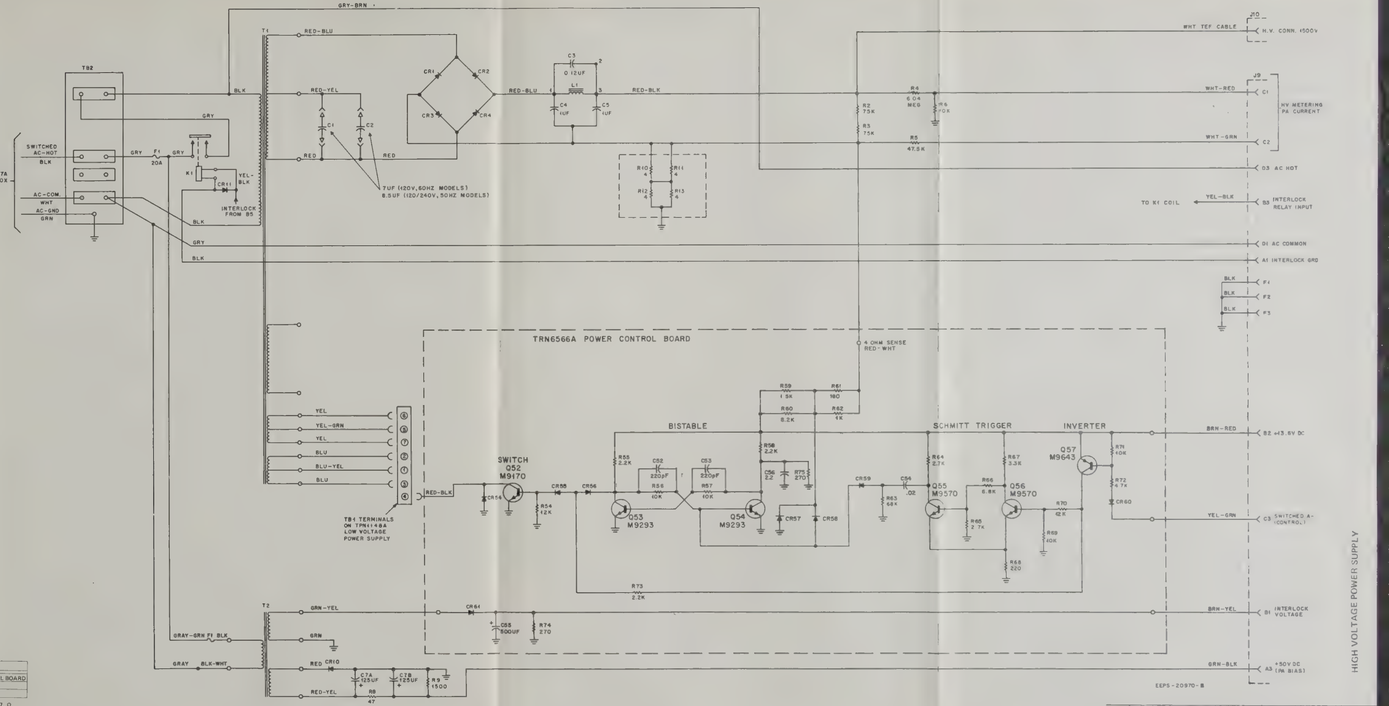


MODEL CHART				
MODEL	SUFFIX	ITEM	SUFFIX	DESCRIPTION
TPN1147A		TRN6566A	1	POWER CONTROL BOARD
		TRN6567A		CHASSIS KIT
		TKN6840A		CABLE KIT

EPS-22427 O



TPN1147A High Voltage Power Supply
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-20971-C
9/1/80-UP

LOW VOLTAGE POWER SUPPLY

MODEL TPN1148A

Model Complement

MODEL	DESCRIPTION
TLN5122A	9.6 and 13.6 Volt Regulator Board
TRN6568A	Filament Regulator Board
TKN6703A	Cable, L.V. Power Supply
TKN6846A	Chassis Cable, L.V. Power Supply
TRN6569A	Chassis and Hardware Kit

1. DESCRIPTION

1.1 This power supply provides the following output voltages:

-- regulated 6.3 volts dc for PA tube filaments.

-- regulated 9.6 and 13.6 volts dc for operation of the solid-state circuitry contained within the transmitter.

-- unregulated 13.6 volts dc for the oscillator oven.

1.2 The low voltage power supply obtains its ac input from the companion high voltage power supply which provides a relatively constant input voltage (±3%) with a source voltage change of ±20%. Transistorized regulator circuits provide highly regulated dc output voltages.

2. THEORY OF OPERATION

2.1 INPUT CIRCUITRY (Refer to diagram PEPS-20976)

Diodes CR1 and CR2 provide full wave rectification of the nominal 14.5 volt ac input applied to TB1-6 and 7. The resulting dc voltage is applied through TB1-5 and fed through a double pi type LC filter to the 6.3 volt regulator on the filament regulator board, and to the 9.6 volt regulator. Diodes CR3 and CR4 provide full wave rectification of the nominal 18.5 volt ac input applied to TB1-2 and 3. The resulting dc voltage, applied through TB1-1, is capacitively filtered and applied to the 13.6 volt regulator. Each regulator circuit is protected from drawing excessive current by a fuse in its input.

2.2 9.6 V AND 13.6 V REGULATORS

2.2.1 General

Except for the voltages involved, the operation of the 9.6 volt and 13.6 volt regulators is the same. The operation of the 9.6 volt regulator is described in the following paragraphs (refer to diagram PEPS-20976).

2.2.2 9.6 V Regulator

2.2.2.1 Output

The 9.6 volt output is derived from a series regulator circuit that uses a higher level A+ as its source. An output voltage sensing circuit regulates the amount of current that is allowed to pass through the series regulator, thus controlling the voltage across the load.

2.2.2.2 Voltage Regulation

Transistors Q1, Q3, and Q4 form the voltage regulating circuit. Regulation is achieved by changing the amount of current to flow through the base of Q2. If the output voltage

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REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION

PARTS LIST

TRN6567A Chassis Kit (HV) PL-4416-C

		CAPACITORS : fixed
C1, C2	8-84717G02	7 uF; ±6%; 660 V
C3, C4, C5	8-82744H01	3-section: .12 uF; ±10%; 4400 V 1 uF; ±10%; 4400 V 1 uF; ±10%; 3600 V
C7A, B	23-82125B13	2-section 125 uF; +100-10%; 100 V
		DIODES
CR1 thru CR4	48-83302A01	silicon HV
CR5	48-82466H18	silicon
CR11	48-82466H13	silicon
		FUSE, cartridge
F1	65-135013	20A
F2	65-817953	.6A
		COIL
L1	25-84480F02	15H; ±10%
		RELAY
K1	80-82015H02	12 V
		RESISTORS, fixed; 10%
R1		NOT USED
R2, 3	17-82906H01	75k; 75 W
R4	6-82672B09	6.04 MEG; ±1%; 2 W
R5	6-82672B08	47.5k ±1%; 1/2 W
R6	6-125C73	10k; 1 2 W
R7		NOT USED
R8	6-126C17	47; 1 W
R9	17-83027H03	1.5k; 3 W
R10-R13	17-82476B06	4 ±1%; 3 W
		TRANSFORMER, power:
		95 to 145 V AC:
T1	25-84507F01	pri: BLK, BLK
		sec No. 1: RED, RED-BLU w/ RED-YEL center tap
		sec No. 2: RED-WHT, RED-WHT
		sec No. 3: BLU, BLU w/BLU-YEL center tap
		sec No. 4: YEL, YEL w/YEL-GRN center tap
		TRANSFORMER, power:
T2	25-82225H01	pri. BLK-WHT: 20 ohms dc resist.
		sec. GRN & GRN-YEL: 0.85 ohms dc resist.
		sec. RED & RED-YEL: 8.6 ohms dc resist.
	NON-REFERENCED ITEMS	
	1-80791B65	CIRCUIT BOARD ASSY, includes 1-80759B65 CIRCUIT BOARD and ref parts R10-R13
	2-7009	NUT: 10-32 x 3/8 x 1/8"; 4 req'd.
	3-3398	WASHER, tapping: 6-20 x 3/8"; 8 req'd.
	3-7506	SCREW, tapping: 6-20 x 1/4" 4 req'd.
	3-82907H01	ROD, threaded: 2 req'd.
	4-7658	WASHER, lock: #10 (split): 4 req'd.
	4-483357	WASHER, Insulating: 203"ID x .500"OD; 4 req'd.
	4-691959	WASHER, insulating: 4 req'd.
	7-82297H01	BRACKET, resistor: .940 x .940"; 4 req'd.
	2-7002	NUT: 6-32 x 5/16 x 7/64": 4 req'd.
	2-115123	NUT: 10-32 x 3/8 x 1/8"; 2 req'd.
	2-119913	NUT: 8-32 x 11/32 x 1/8": 6 req'd.
	2-121841	NUT: 6-32 x 5/16 x 7/64"; 6 req'd.
	3-7229	SCREW, machine: 6-32 x 3/8" 2 req'd.
	3-7297	SCREW, captive: 1/4-20 x 1/2" 4 req'd.
	3-115613	SCREW, machine: 4-40 x 1/4"; 4 req'd.
	3-122777	SCREW, machine: 8-32 x 1/2" 4 req'd.
	3-125541	SCREW, tapping: 6-20 x 1/4"; 4 req'd.
	3-134294	SCREW, tapping: 6-32 x 3/8"; 12 req'd.

TRN6566A Power Control Board PL-5112-A

		CAPACITOR, fixed: uF ±10%; unless otherwise stated
C52, 53	21-847087	220; 300 V
C54	21-82428B26	.02 +80-20%; 200 V
C55	23-83210A19	500 +100-10%; 20 V
C56	23-82783B17	2.2 ±20%; 20 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR54	48-82466H18	silicon
CR55, 56	48-82392B03	silicon
CR57	48-82466H18	silicon
CR58, 59, 60	48-82392B03	silicon
CR61	48-82466H18	silicon
		TRANSISTOR: (SEE NOTE)
Q52	48-869170	NPN; type M9170
Q53, 54	48-869293	NPN; type M9293
Q55, 56	48-869570	NPN; type M9570
Q57	48-869643	PNP; type M9643
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R54	6-124C75	12k
R55	6-124C57	2.2k
R56, 57	6-124C73	10k
R58	6-124C57	2.2k
R59	6-125A53	1.5k ±5%; 1/2 W
R60	6-124A71	8.2k ±5%
R61	6-125A31	180 ±5%; 1/2 W
R62	6-124C49	1k
R63	6-124C93	68k
R64, 65	6-124C59	2.7k
R66	6-124C69	6.8k
R67	6-124C61	3.3k
R68	6-124C33	220
R69	6-124C73	10k
R70	6-124C75	12k
R71	6-124C73	10k
R72	6-124C65	4.7k
R73	6-124C57	2.2k
R74	6-127C35	270; 2 W
R75	6-124C35	270

NOTE: For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

TKN6840A Cable Kit (H.V.) PL-5113-O

		CONNECTOR, receptacle:
J9		includes:
	14-83783A01	INSULATOR, 18-circuit
	29-82335A01	TERMINAL, male: 2 used
	29-82336A01	TERMINAL, female: 11 used
J10	29-10134A59	lug, chain-form (crimp type)
	NON-REFERENCED ITEMS	
	29-847854	LUG, slotted-tongue: 4 used
	42-10217A02	STRAP, cable harness: 15 used

LOW VOLTAGE POWER SUPPLY

MODEL TPN1148A

Model Complement

MODEL	DESCRIPTION
TLN5122A	9.6 and 13.6 Volt Regulator Board
TRN6568A	Filament Regulator Board
TKN6703A	Cable, L.V. Power Supply
TKN6846A	Chassis Cable, L.V. Power Supply
TRN6569A	Chassis and Hardware Kit

1. DESCRIPTION

1.1 This power supply provides the following output voltages:

-- regulated 6.3 volts dc for PA tube filaments.

-- regulated 9.6 and 13.6 volts dc for operation of the solid-state circuitry contained within the transmitter.

-- unregulated 13.6 volts dc for the oscillator oven.

1.2 The low voltage power supply obtains its ac input from the companion high voltage power supply which provides a relatively constant input voltage (±3%) with a source voltage change of ±20%. Transistorized regulator circuits provide highly regulated dc output voltages.

2. THEORY OF OPERATION

2.1 INPUT CIRCUITRY (Refer to diagram PEPS-20976)

Diodes CR1 and CR2 provide full wave rectification of the nominal 14.5 volt ac input applied to TB1-6 and 7. The resulting dc voltage is applied through TB1-5 and fed through a double pi type LC filter to the 6.3 volt regulator on the filament regulator board, and to the 9.6 volt regulator. Diodes CR3 and CR4 provide full wave rectification of the nominal 18.5 volt ac input applied to TB1-2 and 3. The resulting dc voltage, applied through TB1-1, is capacitively filtered and applied to the 13.6 volt regulator. Each regulator circuit is protected from drawing excessive current by a fuse in its input.

2.2 9.6 V AND 13.6 V REGULATORS

2.2.1 General

Except for the voltages involved, the operation of the 9.6 volt and 13.6 volt regulators is the same. The operation of the 9.6 volt regulator is described in the following paragraphs (refer to diagram PEPS-20976).

2.2.2 9.6 V Regulator

2.2.2.1 Output

The 9.6 volt output is derived from a series regulator circuit that uses a higher level A+ as its source. An output voltage sensing circuit regulates the amount of current that is allowed to pass through the series regulator, thus controlling the voltage across the load.

2.2.2.2 Voltage Regulation

Transistors Q1, Q3, and Q4 form the voltage regulating circuit. Regulation is achieved by changing the amount of current to flow through the base of Q2. If the output voltage

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increases, the Q2 base current is decreased, and vice versa. The regulator output voltage is developed across R8 and R9. The voltage developed across R9 reflects all fluctuations of the output load voltage and is applied to the base of Q4. Since the emitter of Q4 is held to 8.2 volts by Zener diode VR1, Q4 conducts in response to the output load voltage fluctuations. When the output load voltage is 9.6 volts, Q4 conducts at a specific level which fixes its collector voltage to a specific level. This voltage level determines the drive to the base of Q3, which determines the drive to the base of Q2. Q1 is a constant current source for the collector of Q4 and the base of Q3. Current through Q1 is held constant because of the voltage drop across CR5 and CR6 which maintains a constant base to emitter bias voltage.

If the 9.6 volt output increases, the Q4 base voltage increases and Q4 conducts harder which causes its collector voltage to decrease. This causes Q3 to conduct less and Q3 collector to draw less current. This decreases the amount of base current Q2 can draw, thus causing the emitter to collector impedance across Q2 to increase. The voltage dropped across Q2 increases, decreasing the output load voltage to normal. If the 9.6 volt output decreases, the above action reverses to bring the output voltage back up to the normal level. For the 9.6 volt regulator, the output voltage may range between 9.0 and 10.2 volts dc. For the 13.6 volt regulator, the output voltage may range between 12.9 and 14.5 volts dc.

2.3 FILAMENT REGULATOR CIRCUIT

The 6.3 volt filament regulator operates in a manner similar to that described for the 9.6 and 13.6 volt regulators (refer to diagram PEPS-20980). This regulator uses an additional amplifier transistor (Q52) to increase the drive voltage available to driver stage Q53. In addition, Q53 is changed to a collector follower instead of an emitter follower. This reduces the minimum voltage drop permitted across series pass stage Q54. Q55 operates as a reference amplifier for the regulating circuitry and its operating point is adjustable by filament voltage control R59.

The 6.3 volt filament regulator employs a filament voltage control to protect the filament during transmission. R59 and R60 provide a voltage divider network used to set the filament voltage. Under unkeyed conditions, the filament control input (from the high voltage power supply) is high, turning Q56 on and removing R60 from the circuit. With Q56 on, the drive to Q55 through R59 is reduced, pulling the collector of Q55 high and increasing the filament voltage to 6.3 volts. When the transmitter is keyed, the filament control input goes low, turning Q56 off. The high impedance of Q56 collector places R60 in the circuit. R60 may now be set to increase the drive to Q55, lowering its collector voltage and reducing the filament voltage to approximately 5.0 volts.

The filament control input also controls the bias output control. A low input (transmitter keyed) will turn on Q57, providing approximately 10 volts at the bias output control.

2.4 TRANSMITTER INHIBIT CIRCUIT

Upon initial turn-on, the transmitter inhibit circuit disables the transmitter for approximately 68 seconds, allowing the tube filaments in the final power amplifier to warm up (refer to diagram PEPS-20980).

When power is applied to the station, three things happen:

-- 60 Hz signal is applied to IC52A.
-- The counter is reset (pin 11) and output pin 2 goes to logic 0.
-- The 6.3 volt output from the filament regulator board is inverted (Q58) and applied to pins 12 and 13 on IC52D.

The high output from IC52D is fed to IC52C and IC52B, and the high output from IC52B fed back to IC52A. IC51 is now enabled and will count for approximately 68 seconds. When the counter output goes high, the output to IC52B goes low. This low is fed back to pin 1 on IC52A, locking the counter in this state. The high counter output is also fed to IC52C. The resulting low turns Q60 off, enabling the transmitter.

C62 provides a spike pulse to reset the counter when power is initially applied. C63 provides transient protection for the low power CMOS logic chips.

NOTE

Low power CMOS chips are used. Consult 68P81106E64 before starting repair or maintenance procedures.

3. MAINTENANCE

Isolate malfunctions of this power supply following conventional troubleshooting procedures.

Note that the ac input voltages to the power supply are not sinusoidal and, thus, cannot be measured with a standard ac voltmeter. All voltage checks must be made where dc voltages are present.

CAUTION

Turn the power to the station off and allow time for the capacitors to discharge through their bleeder resistors before attempting to replace components or repair this power supply.

4. FILAMENT VOLTAGE ADJUSTMENT

The filament voltage MUST be readjusted whenever the power amplifier tube is replaced. To make the adjustment, two controls are set while monitoring the filament voltage at the output terminals with a voltmeter. Proceed as follows:

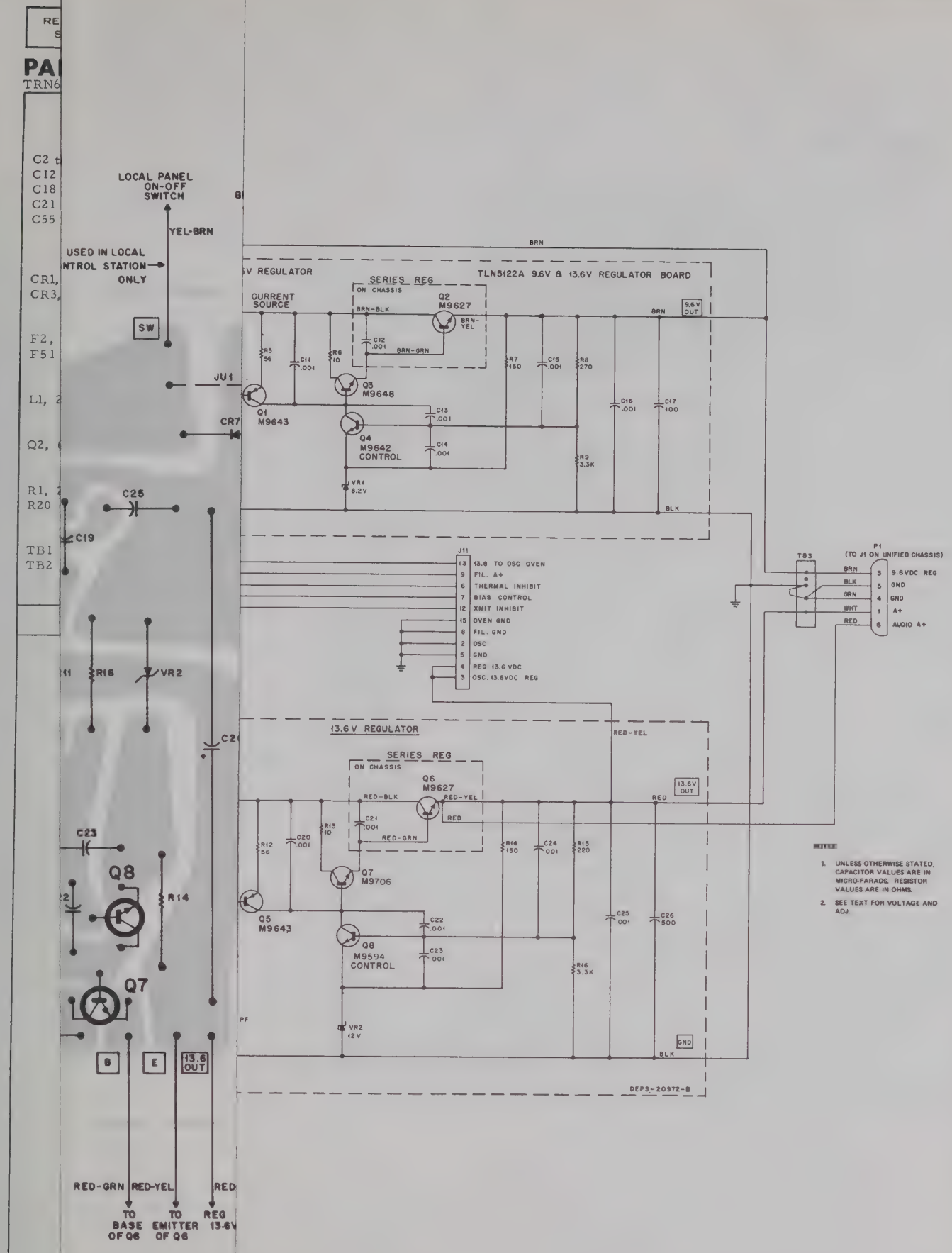
Step 1. Turn on the power to the station and make sure that all interlock switches are closed.

Step 2. Set filament voltage control R59 on the filament regulator board to its midpoint position. Allow the power amplifier tube filaments to warm-up and stabilize for a minimum of two minutes.

Step 3. Connect the VOM across the 6.3 volt output terminals. Set R59 to obtain 6.3 volts. Allow voltage to stabilize for one minute. Repeat until voltage stabilizes.

Step 4. With the VOM still connected across the 6.3 volt output, key the transmitter.

Step 5. Set R60 to obtain a 5 volt reading on the VOM.



LOW VOLTAGE POWER SUPPLY

TLN5122A 9.6 and 13.6 V Regulator Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-20976-C
9/1/80- UP

PARTS LIST

TKN6568A Chassis and Hardware PL-4425-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%, 100 V: unless otherwise stated
C2 thru 9	23-83093G26	17500 +150-10%; 20 V
C12	21-82187B14	.001
C18	23-82304B16	5000 +150-10%; 35 V
C54	21-82187B14	.001
C55	21-82187B14	.001
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2	1-80739B59	silicon
CR3, 4	48-82525G13	silicon
F2, 3	65-4-1688	FUSE, cartridge: 4A: 250 V
F51	15-817956	5A: 250 V
L1, 2	25-84514G01	COIL, choke: 250 uH
Q2, 6, 54	48-869627	TRANSISTOR: (SEE NOTE) NPN: type M9627
R1, 2	17-81389Q02	RESISTOR, fixed: 10 ±5%; 20 W
R20	17-86137b	1 ±10%; 25 W
TB1	31-82596E02	TERMINAL BOARD: 7-terminal
TB2	31-50378	2-terminal

NON-REFERENCED ITEMS

	1-80785B74	CHASSIS ASSEMBLY Includes:
	9-84935D01	SOCKET, transistor: 3 req'd.
	27-84139G02	CHASSIS, power supply
	31-118964	TERMINAL STRIP: 5-lug
	31-120365	TERMINAL STRIP: 3-lug
	64-850015	PLATE, capacitor mounting: 9 req'd
	2-7007	NUT: 8-32 x 1/4 x 3/32; 2 req'd.
	2-119913	LOCKNUT: 8-32 x 11/32 x 1/8"; 3 req'd.
	2-135435	NUT: 1/4-20 x 7/16 x 5/32"
	3-114933	SCREW, machine: 8-32 x 1-1/4"; 2 req'd.
	3-122777	SCREW, machine: 8-32 x 1/2"; 2 req'd.
	3-125913	SCREW, tapping: 6-18 x 1/2" 6 req'd.
	3-127914	SCREW, tapping: 6-32 x 1/4" 4 req'd.
	3-136140	SCREW, tapping: 8-32 x 5/8" 6 req'd.
	3-139147	SCREW, tapping: 8-16 x 5/8" 4 req'd.
	3-410095	SCREW, machine: 1/4-20 x 5/8"
	3-488100	SCREW, machine: 6-32 x 1-1/4"; 4 req'd.
	4-7651	WASHER, lock: #8 (split): 4 req'd.
	4-7666	WASHER, lock: #6 (split): 6 req'd.
	4-7670	WASHER, lock: #1/4 (internal tooth)
	14-865854	INSULATOR, transistor: 3 req'd.
	14-84548A01	WASHER, insulating: 2 req'd.
	29-134176	LUG, soldering: (.250): 2 req'd.
	29-835302	LUG, ring tongue: #1/4: 2 req'd.
	29-845081	LUG, ring tongue: #3/8: 2 req'd.
	29-847854	LUG, slotted tongue: #6: 5 req'd.
	29-859665	LUG, ring tongue
	42-10217A02	STRAP, cable harness: 4 req'd.
	43-864364	SPACER, threaded: 4 req'd.
	43-83620H01	SPACER, .940" lg.: 4 req'd.
	43-84510G01	SPACER, .40" lg.: 4 req'd.
	7-820371L01	BRACKET, connector
	3-122316	SCREW, machine: 8-32 x 2-1/2"
	4-852296	WASHER, shoulder: 2 req'd.
	4-7657	WASHER, lock: #8 (external tooth)
	4-7582	WASHER, flat: .195 x .500 x .033"

TKN6703A Cable, Low Voltage Power Supply PL-2857-D

	9-84151B01	CONTACT, receptacle: 5 req'd
	14-84590B01	INSULATOR, connector
	42-10217A02	STRAP, cable: 11 req'd

TKN6846A Cable Assembly PL-4426-A

J11		CONNECTOR, receptacle: includes:
	14-82836H01	HOUSING, connector (15-contact)
	29-82336A01	CONTACT, female: 11 req'd.

NON-REFERENCED ITEMS

	29-847854	LUG, slotted tongue: 5 req'd.
	29-859665	LUG, ring tongue: 3 req'd.
	42-10217A02	STRAP, cable harness: 11 req'd.

REVISIONS PEPS-20976-B

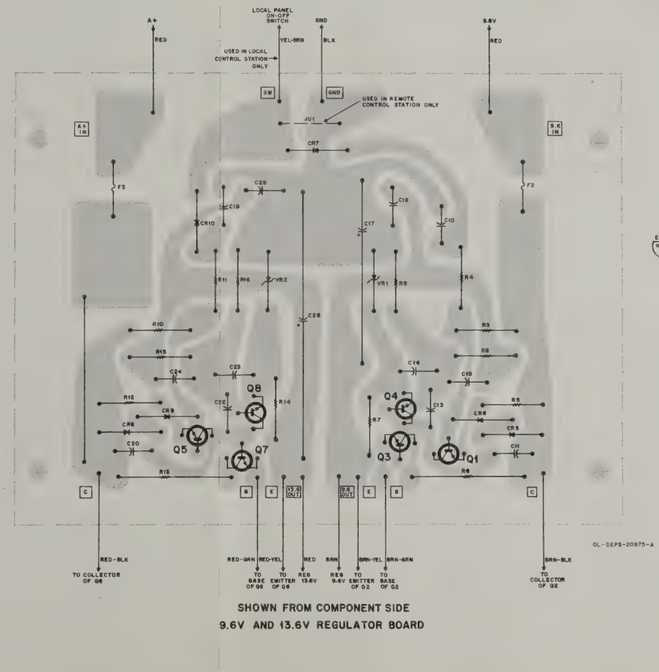
CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN5122A-1	Q7	FROM 48-869648, M9648 TO 48-869706, M9706	13.6 V SERIES REGULATOR
	Q8	FROM 48-869642, M9642 TO 48-869594, M9594	

TLN5122A Regulator Board PL-4424-A

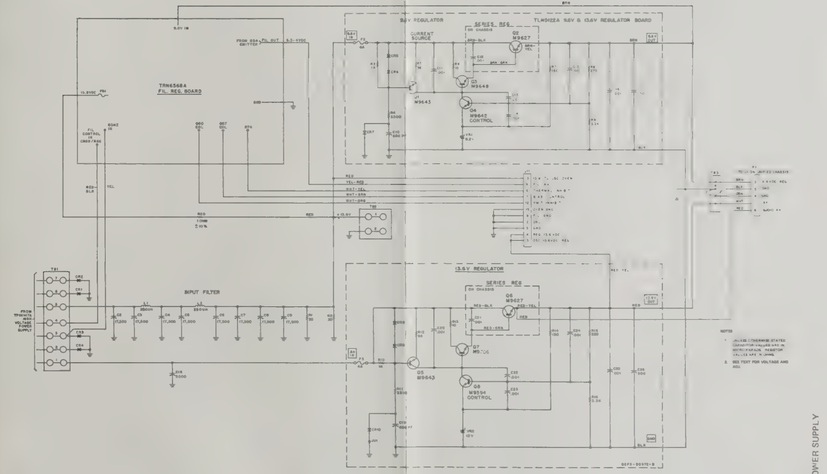
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%, 100 V unless otherwise stated
C10	21-848236	650 pF ±5%; 300 V
C11	21-82187B20	.001
C13 thru 16	21-82187B20	.001
C17	23-82601A25	100 -10+150%; 20 V
C19	21-848236	650 pF ±5%; 300 V
C20	21-82187B20	.001
C22 thru 25	21-82187B20	.001
C26	23-83210A19	500 -10+100%; 20 V
CR5 thru 10	48-836541H01	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) Silicon
		TRANSISTOR: (SEE NOTE)
Q1	48-869643	PNP; type M9643
Q3	48-869648	NPN; type M9648
Q4	48-869642	NPN; type M9642
Q5	48-869643	PNP; type M9643
Q7	48-869706	NPN; type M9706
Q8	48-869594	NPN; type M9594
		RESISTOR, fixed: ±10%; 1/4 W unless otherwise stated
R3	6-124C49	1k
R4	6-124C61	3.3k
R5	6-124C19	56
R6	6-126C01	10; 1 W
R7	6-124C29	150
R8	6-124A35	270 ±5%
R9	6-124A61	3.3k ±5%
R10	6-124C47	1k
R11	6-124C49	3.3k
R12	6-124C19	56
R13	6-126C01	10; 1 W
R14	6-124C29	150
R15	6-124A33	220 ±5%
R16	6-124C61	3.3k ±5%
		SEMICONDUCTOR DEVICE, (SEE NOTE)
VR1	48-82256C08	Zener, 8.2 V
VR2	48-82256C25	Zener, 12 V

NON-REFERENCED ITEM

	42-82690A01	CLIP, fuse; 4 req'd.

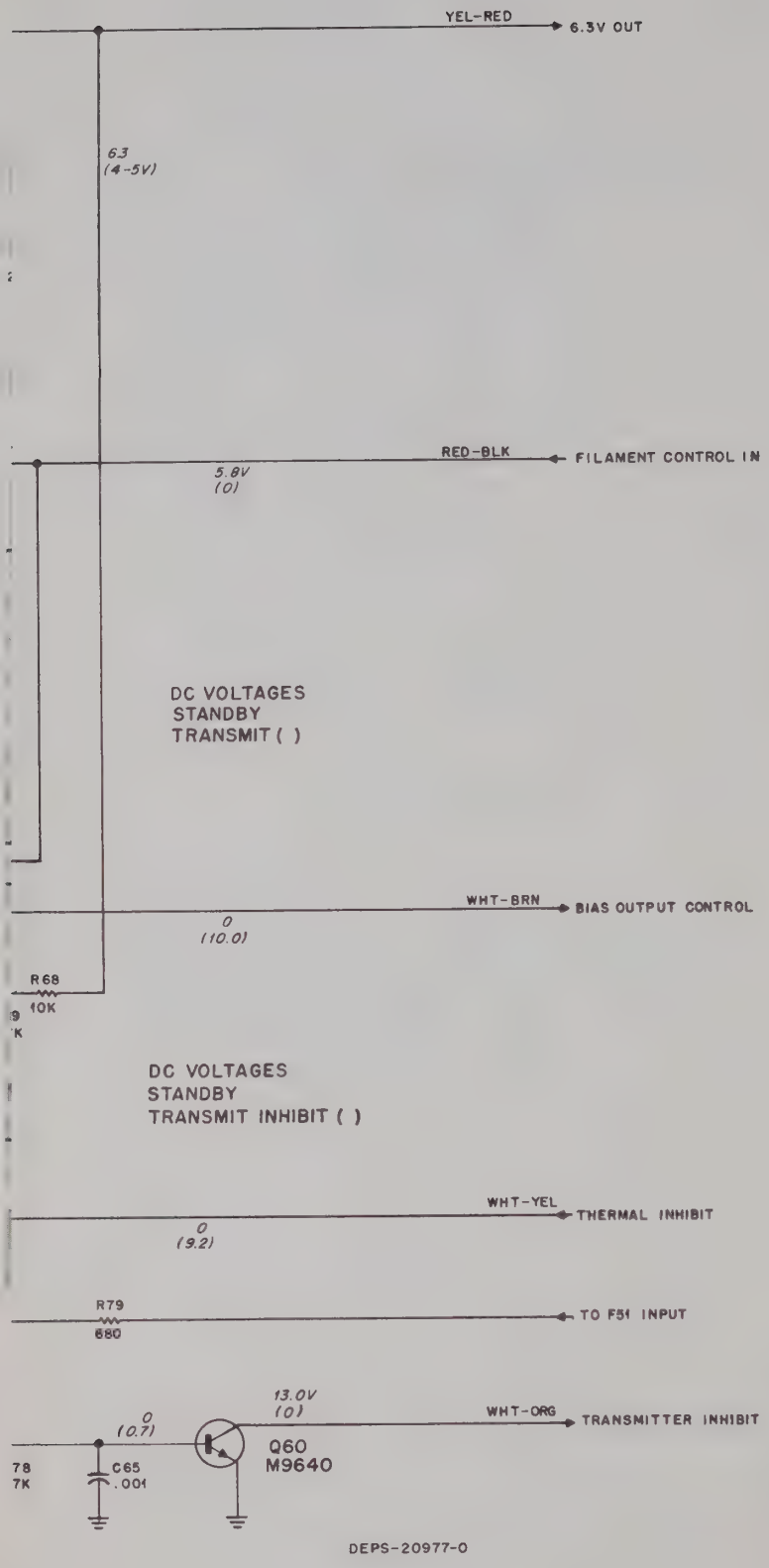


SHOWN FROM COMPONENT SIDE
9.6V AND 13.6V REGULATOR BOARD



TLN5122A 9, 6 and 13, 6 V Regulator Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-20976-C
9/1/80-UP

LOW VOLTAGE POWER SUPPLY


YEL-RED
6.3V OUT
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BIAS OUTPUT CONTROL
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R68
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DC VOLTAGES
STANDBY
TRANSMIT INHIBIT ( )
WHT-YEL
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TRANSMITTER INHIBIT
Q60
M9640
78
7K
C65
.001

DEPS-20977-0

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4. ☐ Are difficult to follow

If you have checked any box except 1, please tell us what schematic diagrams, or portions thereof, were at fault, or enter other comments.*

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68P85901D80-L

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3. ☐ Some instruction sections are too long or superfluous such as*

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4. ☐ Other comments*

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TAPE & MAIL
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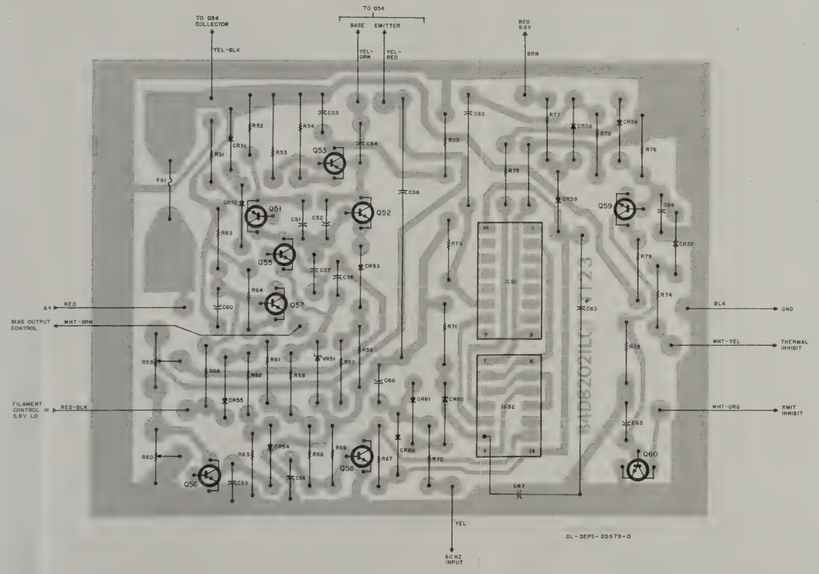
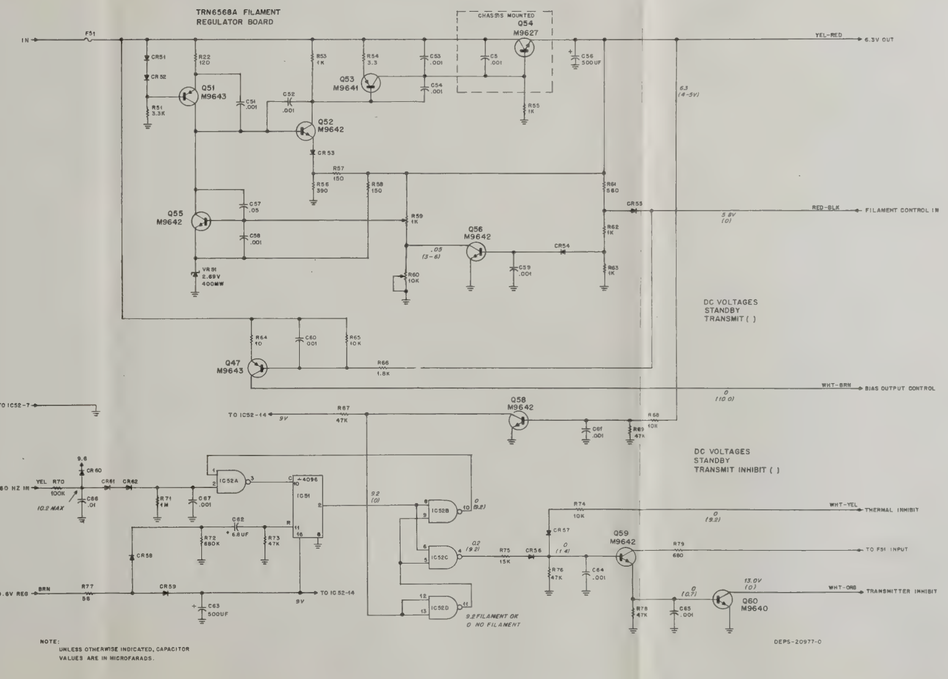
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TRN6568A Filament Regulator Board P1-4423-A

		CAPACITOR, fixed: uF ±10%; 100 V; unless otherwise stated
C51 thru 54	21-82187B20	.001
C55	23-83210A19	500 ±10%; 20 V
C56	21-82372C07	.05 +80-20%; 25 V
C58 thru 61	21-82187B20	.001
C62	23-83214C05	6.8 ±20%; 15 V
C63	23-83210A19	500; 20 V
C64, 65	21-82187B20	.001
C66	21-83250I	.01 uF
C67	21-82187B20	.001 uF; 100 V
		DIODE: (SEE NOTE)
CR51 thru 62	48-83654H01	silicon
		FUSE, cartridge:
F51	65-817956	5 Amp; 250 V
		INTEGRATED CIRCUIT: (SEE NOTE)
IC51	51-84887K12	MC14020BCP
IC52	51-84887K64	MC14093CP
		RESISTOR, fixed, 10% 1/4 W,
R51	6-124C61	3.3k
R52	6-124C27	120
R53	6-124C49	1k
R54	6-125B57	3.3; ±5%; 1/2 W
R55	6-124C49	1k
R56	6-124C39	390
R57,58	6-124C29	150
R59	18-83083G	variable; 1k
R60	18-83083G10	variable; 10k
R61	6-124C43	560
R62, R63	6-124C49	1k
R64	6-124C01	10
R65	6-124C73	10k
R66	6-124C55	1.8k
R67	6-124C89	47k
R68	6-124C73	10k
R69	6-124C89	47k
R70	6-124C97	100k
R71	6-124C22	1 MEG
R72	6-124B18	680k; ±5%
R73	6-124C89	47k
R74	6-124C73	10k
R75	6-124C77	15k
R76	6-124C89	47k
R77	6-124C19	56
R78	6-124C89	47k





NOTE:
UNLESS OTHERWISE INDICATED, CAPACITOR VALUES ARE IN MICROFARADS.

TRN6568A Filament Regulator Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-20980-A
3/30/78- UP

MOTOROLA

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If you have checked any box except 1, please tell us what schematic diagrams, or portions thereof, were at fault, or enter other comments.*

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4. ☐ Other comments*

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My name is _____

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City _____ State _____ Zip _____

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AVAILABLE BACKGROUND REFERENCE PUBLICATIONS

Five reference publications are available to provide background information needed to service some of the newer Motorola products more effectively. The information in these publications is not duplicated in our instruction manuals. To obtain your free copy, check the ones you want and return this self-mailer to us. (NOTE: One copy of each publication has already been distributed to Motorola Service Shops (MSS's) and field technical representatives (FTR's).

Check item desired:

☐ **Basic Logic Circuit Guide** — 68P81105E88
Describes the basic logic circuits used in Motorola Communications digital equipment and the logic notational scheme used in our instruction manuals.

☐ **"Digital Private-Line" Binary-Coded Squelch** — 68P81106E83
Contains fundamentals of "Digital Private-Line" system operation, circuit operation and servicing techniques.

☐ **Safe Handling of CMOS Integrated Circuit Devices** — 68P81106E84
Describes special handling techniques needed to prevent irrepairable damage from static charges encountered with normal handling of CMOS devices.

☐ **Reducing Noise Interference in Mobile Two-Way Radio Installations** — 68P81109E33
Defines the major sources of noise encountered in a mobile radio installation and suggests methods of remedying them.

☐ **Anti-Skid Braking Precautions** — 68P81109E34
Provides installation suggestions and a detailed checkout procedure for installation of mobile radios in vehicles with anti-skid braking systems.

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